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REDUCTION IN GRAIN YIELD FROM THE F_1 TO THE F_2 OF PARENTAL SINGLE-CROSSES AND DOUBLE-CROSS HYBRIDS [1]

O. Q. Ballesteros, I. S. Santos, and F. A. Aquilizan

In the 1955-56 dry season performance test of parental single-crosses and double-cross hybrids and their respective F_2's, these results were obtained: (1) percentage decreases in the grain yield of the F_2 of 5 parental single crosses varied from 0.8 to 22.8 per cent, with a mean of 17.3 per cent and (2) percentage decreases in the grain yield of the F_2 of 7 double-cross hybrids varied from 1.4 to 37.5 per cent, with a mean of 17.6 per cent. On the average, the F_2 yielded significantly lower than the F_1.

In the United States and other countries where hybrid corn is in use, farmers are generally advised to use first-generation (F_1) seed for each and every planting. This recommendation is based on experiments which have shown that a yield reduction as compared to the F_1 can be expected with the use of advanced generation seed. There is always a tendency, however, for farmers to use F_2 seed partly to avoid the expense of buying seed each year and sometimes because of the inadequate supply of F_1 seed. This study was conducted to determine whether or not and to what degree, yields under Philippine conditions are reduced by using F_2 as compared with F_1 seed.

Studies in other countries, particularly the United States, have shown that production of grain in isolated varieties or hybrids was significantly reduced due to forced inbreeding (Jones, 1922). Neal (1935) reported that single crosses showed a greater reduction in yield potential than double crosses (29.5% vs. 15.8%) when F_1 and F_2 progenies were compared in replicated field trials. Three-way hybrids were intermediate in their F_1 to F_2 yield reduction (23.4%).

Jenkins (1935) confirmed Neal's finding in that his data indicated that reduction in yield, when seed was saved from fields of hybrid corn, was greatest for single crosses and progressively less as the number of hybrids entering the cross was increased.

In Mexico, Wellhausen (1954) indicated that the advanced-generation progeny of double top crosses showed an average yield of

[1] Central Experiment Station Contribution No. 1928.

126% of the locally grown variety Urquiza. However, this yield advantage was a little more than half of what was gained with the F_1 double top crosses. Theoretically, one might expect an F_2 planting to exhibit half the gain attained in the first generation hybrid harvest.

The feasibility of utilizing advanced-generation single crosses in the production of double-crossed seed was determined by Kiesselbach (1930). There was no significant difference between the yield of the resulting hybrid through the use of F_2 generation and that of F_1 generation single crosses. The mean yield of the F_1 and F_2 were 54.4 and 54.9 bushels per acre, respectively.

Wright, (cited by Richey, 1950) reported that the yield of F_2 or other advanced-generation hybrids under random mating can be predicted with the use of this formula,

$$F_2 = F_1 - \frac{(F_1 - P)}{n}$$

where n represents the number of parent lines, P, their mean yield, and F_1, the mean yield of the first-generation cross. This formula is based on the assumption that the action of the genes governing yield is additive and simple.

MATERIALS AND METHODS

The tests were conducted in the Division of Plant Breeding, College of Agriculture, during the 1955 dry season and the 1956 wet season. The first crop was planted in November, 1955 and the second in May, 1956. The 1956 wet season planting which was badly attacked by downy mildew was abandoned. Excellent data were obtained from the dry season crop which was harvested in early March.

Four single crosses and seven double crosses of both F_1 and F_2 generations were grown as shown in tables 1, 3 and 6. Inbreds A102, A103, A104, A105, A106, and A107 were derived from College Yellow and inbreds A110, A111, A112, and A113 were from Cuban Yellow.

The split-plot randomized block design with 3 replications as illustrated by Cochran and Cox (1950) was used. The 12 hybrids constituted the main plots. The generations (F_1 and F_2) were assigned at random to the two subplots of each main plot. Each plot was composed of two rows. Rows were one meter apart and had

10 hills each spaced one meter. Each hill was planted with five kernels but was thinned to three plants afterwards.

Ammonium phosphate fertilizer (16-12-0) at the rate of 250 kg. per hectare was applied when the plants were two weeks old. Calibrated containers were used to insure a uniform rate of fertilizer application per hill. On December 7, 1955 when the plants were about 30 centimeters tall, 2,4-D amine at the rate of one-half pound per acre was sprayed uniformly over the experimental field. The broad-leafed weeds were adequately controlled. The corn plants were also slightly affected as shown by the proliferation of the roots, bending of the stalks and rolling of the leaves. They recovered fully 14 days after spraying.

Plants inclining 45° or more from the vertical were considered root-lodged; those that broke below the primary or first ear were considered stalk-lodged. The date of silking was recorded when 50 per cent of the plants in the plot had silked.

The number of missing hills in each plot was observed and recorded after cultivation. Plant height was taken two weeks after silking. A meter stick was placed at the middle of each row and "guessed" means for plant height and for ear height were taken. Plant height was considered as the distance between the ground level and the tassel tip; ear height, between the ground level and the node to which the first ear is attached. Readings for the three replications for both plant and ear height were averaged.

Determination of grain yield was based on all the plants in the plot (two rows of 10 hills each). Moisture content of the shelled grains from each plot was determined with the use of the Universal Electronic Moisture Tester. Plot yields were corrected for missing hills using this formula:

$$\text{Corrected weight} = \text{Field weight} \times \frac{(\text{No. of hills/plot}) - (0.3 \times \text{No. of missing hills/plot})}{(\text{No. of hills/plot}) - (\text{No. of missing hills/plot})}$$

This adjustment adds 0.7 of the average hill yield for each missing hill, and assumes that 0.3 is made up by the increased yield of surrounding hills. Plot yields in pounds of shelled corn were then converted into cavans per hectare at 15 per cent moisture.

RESULTS AND DISCUSSION

Grain yield

Although the single crosses and double crosses were grown in one experiment, it was found desirable to make separate analysis involving each group.

Single Crosses. Table 1 shows the grain yields of the F_1 single crosses and those of their respective F_2's, by replication. The mean is given in the sixth column and the decrease from F_1 to F_2 in per cent of the F_1 is given in the second-to-the-last column.

TABLE 1.—*Grain yield (cavans per hectare) of single crosses and of their respective F_2's*

SINGLE CROSS	GENERATION	REPLICATION			MEAN	DECREASE OF F_2 IN PER CENT	SINGLE CROSS MEAN
		I	II	III			
A102 × A103	F_1	35.3	55.7	43.3	44.8		
	F_2	30.7	32.0	41.1	34.6	22.8	39.7
A102 × A106	F_1	41.6	48.2	49.6	46.5		
	F_2	41.1	42.0	42.0	41.7	10.3	44.1
A103 × A105	F_1	39.5	46.1	50.0	45.2		
	F_2	29.5	38.6	41.5	36.5	19.2	40.9
A104 × A105	F_1	39.0	44.9	40.6	41.5		
	F_2	21.7	32.0	29.0	27.6	33.5	34.6
A112 × A113	F_1	28.7	39.0	45.3	37.7		
	F_2	38.8	37.7	35.7	37.4	0.8	37.6
Replication mean		34.6	41.6	41.8	39.3	17.3	39.3

Generation means	F_1	F_2
	43.1	35.6

Table 2 provides the analysis of variance for the grain yields. The mean squares for varieties and replications were highly significant; that for generation (F_1 vs. F_2), significant. The S.M.D.'s are shown in the last two columns, at 0.05 and at 0.01 levels, respectively. The coefficient of variability (17.8%) was relatively high as compared to 15% which is commonly considered for corn as the upper limit of acceptability.

Block I had a mean yield (34.6 cavans per hectare) that was highly and significantly lower than those of Blocks II and III (41.6 and 41.8 cavans per hectare, respectively). Block I was located at a slightly higher portion in the field. During shortage of precipitation, the higher portions of the field generally retain less moisture than the lower portions. This explains at least in part the low yields in Block I.

The S.M.D. at 0.05 level for comparing F_1 and F_2 grain yields for each single cross was 11.5 cavans per hectare. It was only in A104 x A105 where the F_1 significantly outyielded the F_2. The F_2

TABLE 2.—*Analysis of variance for grain yields shown in table 1*

SOURCE OF VARIATION	DF	MS	CF	S.M.D.	
				0.05	0.01
Varieties (V)	4	76.98	9.12 [a]	5.5	8.0
Replications (R)	2	169.31	20.06 [a]	4.2	6.2
V × R	8	8.44			
Generations (G)	1	428.66	8.69 [b]	6.4	—
G × V	4	41.11			
Pooled error	10	49.33			

[a] Significant at 1 per cent level.
[b] Significant at 5 per cent level.
C.V = 17.8%

mean (35.6) for all varieties was, however, significantly lower than the F_1 mean (43.1). The percentage decrease varied from 0.8 to 22.8 per cent, the mean being 17.3 per cent. The lone Cuban Yellow single cross, A112 x A113, which had the lowest grain yield in the F_1 also had the lowest percentage decrease (0.8 per cent). All F_1 yields of the College Yellow single crosses (all others in table 1) were higher than the F_1 of the Cuban Yellow single cross. In the 1953 wet season test [2] of single crosses, the College Yellow single crosses definitely yielded higher than the Cuban Yellow single crosses. Among the College Yellow single crosses included in the present study, A102 x A106 had the highest F_1 yield and the lowest percentage decrease (10.3 per cent) from the F_1 to the F_2.

It should be noted from the title of table 1 that the term *single crosses* is used instead of single-cross hybrids. Single crosses between two related inbred lines can not rightfully be called single-cross hybrids. The writers would want to suggest the term *parental single crosses* to refer to those single crosses that are used as parents in the production of double crosses in contrast to those single crosses that are grown to produce the commercial crop. A single cross, however, may be both a single-cross hybrid and a parental single cross at the same time.

The F_2 seeds of a parental single cross are often used for planting the pollen rows in a double-crossing field. This would not result in a decreased production of F_1 double-crossed seeds since these seeds are produced on the plants in the seed rows and the possible slight decrease in pollen production of the F_2-seed-planted pollen rows

[2] Unpublished data from corn yield tests conducted by the Plant Breeding Division, Department of Agronomy.

would not hurt seed-setting at all. However, if the F_2 yield of a parental single cross is known to be only slightly less than the F_1, then the F_2 of this single cross may be used as the seed parent. Roguing may be a little more difficult since the F_2 is generally more variable than the F_1. Total or partial resort to F_2 seeds of both parental single crosses of a double cross may be made in cases of failure to produce sufficient F_1 seeds.

Double-cross hybrids. Table 3 shows the grain yields of seven double-cross hybrids and those of their respective F_2's in the same arrangements as shown in table 1.

TABLE 3.—*Grain yield (cavans per hectare) of double-cross hybrids and of their respective F_2's*

DOUBLE CROSS	GENERATION	REPLICATION			MEAN	DECREASE OF F_2 IN PER CENT	DOUBLE CROSS MEAN
		I	II	III			
(A102 × A103)	F_1	47.6	57.5	58.3	54.5		
(A110 × A112)	F_2	52.5	53.5	48.0	51.3	5.9	52.9
(A102 × A104)	F_1	52.1	46.1	46.4	48.2		
(A110 × A112)	F_2	43.7	35.3	47.8	42.3	12.2	45.3
(A102 × A105)	F_1	48.4	56.8	46.2	50.5		
(A110 × A112)	F_2	44.2	55.4	49.7	49.8	1.4	50.2
(A103 × A105)	F_1	55.4	54.6	58.0	56.0		
(A110 × A112)	F_2	42.7	44.0	54.2	47.0	16.1	51.5
(A102 × A107)	F_1	51.9	63.2	60.8	58.6		
(A111 × A113)	F_2	41.8	48.4	36.1	42.1	28.2	50.4
(A103 × A107)	F_1	63.3	59.5	57.1	60.0		
(A111 × A113)	F_2	41.8	44.4	26.3	37.5	37.5	48.8
(A105 × A107)	F_1	63.6	49.7	56.7	56.7		
(A111 × A113)	F_2	41.4	51.7	39.7	44.3	21.9	50.5
Replication mean		49.3	51.4	49.0	49.9	17.6	49.9

Generation means	F_1	F_2
	54.9	44.9

The analysis of variance is shown in table 4. Only the mean square for generation was highly significant.

The S.M.D. for comparing F_1 and F_2 grain yields for each double-cross hybrid was 17.1 and 24.4 cavans per hectare, respectively, at 0.05 and 0.01 levels. Only in (A103 × A107) (A111 × A113) did the F_1 significantly outyield the F_2.

TABLE 4.—*Analysis of variance for grain yields shown in table 3*

SOURCE OF VARIATION	DF	MS	CF	S.M.D.	
				0.05	0.01
Varieties (V)	6	35.23			
Replications (R)	2	25.23			
V × R	12	39.53			
Generations (G)	1	1,056.01	10.38 [a]	6.6	9.2
G × V	6	88.74			
Pooled error	14	101.71			

[a] Significant at 1 per cent level.
C.V. = 20.2%

The mean yield of the F_1's of the seven double crosses was 54.9 cavans per hectare as against 44.9 for the F_2's, the difference being 10.0 cavans per hectare. The S.M.D. at 0.01 level was 9.2 cavans per hectare.

The percentage decreases ranged from 1.4% to 37.5%, the mean being 17.6%. In general, the percentage decreases in yield in the F_2 were greater for the high-yielding double-cross hybrids than for the lower yielding hybrids. Thus, the decrease for the highest yielding double cross (A103 × A107) (A111 × A113) was 22.5 cavans per hectare or 37.5 per cent. The decrease for the second highest yielding double cross (102 × A107) (A111 × A113) was 28.2 per cent. On the other hand, the decrease in yield for the second to the lowest in yield, (A102 × A105) (A110 × A112), was only 1.4 per cent, the least of any hybrid.

The results of this study also indicate that some hybrids are better suited for the production of synthetics because the F_2 of such hybrids yield even more than the F_2 of higher yielding F_1 hybrids. An example of this is the double cross (A102 × A105) (A110 × A112). Its F_2 yield was 49.8 cavans per hectare which was very much more than the F_2 yield (37.5 cavans per hectare) of the highest yielding double cross, (A103 × A107) (A111 × A113).

Effect of rainfall on yield. For optimum growth and grain production, a well distributed rainfall throughout the growing season is necessary (Jenkins, 1941). Corn urgently needs a plentiful supply of moisture at the time of silking and tasseling.

A summary of the monthly rainfall during the growing season is presented in table 5.

As a dry season crop, the yield level during the 1955-56 dry season was relatively high as compared to the 1954-55 dry season crop.

TABLE 5.—*Mean monthly rainfall during the growing season*

MONTH	RAINFALL
November, 1955	80.100
December, 1955	5.725
January, 1956	10.450 [b]
February, 1956	9.200 [c]
March, 1956	2.300 [b]

[a] Data compiled by the Weather Station, U. P. College of Agriculture.
[b] One week with trace observations–amount of rainfall was 0.005 inch or less.
[c] Two weeks with trace observations–amount of rainfall was 0.005 inch or less.

Rainfall was satisfactory in November but not so in December and January. If rainfall in December, 1955 were more nearly normal for that month, yields no doubt would have been considerably higher.

Other agronomic characters

Plant height, ear height, and days to silking. Table 6 is a summary of plant height, ear height, number of days from planting to silking, and grain yields of both parental single crosses and double-cross hybrids.

TABLE 6.—*Plant height, ear height, days to silking, and grain yields of the different F_1 single and double-crosses and of their respective F_2's*

HYBRID	PLANT HEIGHT		EAR HEIGHT		DAYS TO SILKING		GRAIN YIELD	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
	cm.		*cm.*		*number*		*cav./ha.*	
A102 × A103	203	195	82	83	55	57	44.8	34.6
A102 × A105	168	185	82	83	52	57	44.6	41.7
A103 × A105	182	185	73	73	55	58	45.2	36.5
A104 × A105	178	172	68	57	55	55	41.5	27.6
A112 × A113	200	208	85	100	63	64	37.7	37.4
(A102 × A103) (A110 × A112)	222	205	98	93	59	59	54.5	51.3
(A102 × A104) (A110 × A112)	212	227	93	93	59	59	48.2	42.3
(A102 × A105) (A110 × A112)	223	222	103	100	59	58	50.5	49.8
(A103 × A105) (A110 × A112)	208	193	93	72	59	59	56.0	47.0
(A102 × A107) (A111 × A113)	213	198	93	83	59	59	58.6	42.1
(A103 × A107) (A111 × A113)	225	200	85	83	59	64	60.0	37.5
(A105 × A107) (A111 × A113)	207	198	90	88	57	59	56.7	44.3
Mean	203	199	87	84	58	59	49.9	41.0

The means of the F_1's and F_2's for each agronomic character are shown in the last line of the table. The mean difference for plant height was 4 centimeters; for ear height, 3 centimeters. These mean differences are very small and it can safely be stated that in general the F_1 and F_2 means were almost identical. The differences between F_1 and F_2 means in certain single crosses or double crosses were most probably within the limits of experimental error. Differences were as large as 25 centimeters. However, in some cases the F_1 mean was larger and in other cases, the F_2 mean was larger.

For number of days from planting to silking, the same general relation between F_1 and F_2 mean existed for plant and ear heights. The over-all means were 58 and 59 days for F_1 and F_2, respectively —a mean difference of only one day. A few cases, however, seemed anomalous. For example, in the case of (A103 × A107) (A111 × A113), there was a difference of five days between the F_1 and the F_2.

The single crosses generally had lower plant and ear heights, grain yields, and they silked earlier than the double crosses. College Yellow single crosses are generally shorter and they mature earlier than Cuban Yellow single crosses. The double crosses, which had a Cuban Yellow single cross as one parent, were therefore expected to be taller and later-maturing than the College Yellow single crosses. Since Cuban Yellow single crosses yield on the average less than the College Yellow single crosses, the higher yields of the double crosses can only be explained on the basis of heterosis resulting from the crossing of unrelated parents. College Yellow and Cuban Yellow single crosses are considered unrelated to each other.

Diseases and pests. There was a slight attack of downy mildew (*Sclerospora philippinensis* Weston), rust (*Puccinia sorghi* Schw.), brown spot (*Physoderma zea-maydis* Shaw) and leaf spot (*Helminthosporium maydis* Nishikado and Miyake). The pests observed attacking the corn plants were the European corn borer (*Pyrausta nubilalis* Hubner) and corn ear worm (*Heliothis armigera* Hubner). The damage done by these plant pathogens and insect pests, however, was very negligible and was therefore considered unimportant.

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General impressions are never to be trusted. Unfortunately when they are of long standing they become fixed rules of life, and assume a prescriptive right not to be questioned. Consequently those who are not accustomed to original inquiry entertain a hatred and a horror of statistics. They cannot endure the idea of submitting their sacred impressions to cold-blooded verification. But it is the triumph of scientific men to rise superior to such superstitions, to desire tests by which the value of beliefs may be ascertained, and to feel sufficiently masters of themselves to discard contemptuously whatever may be found untrue.

—Francis Galton

* * *

When tillage begins, other arts follow. The farmers, therefore, are the founders of human civilization.

—Daniel Webster

EFFECT OF HARVESTING KENAF AT DIFFERENT STAGES OF MATURITY ON THE YIELD AND QUALITY OF THE FIBER [1]

FELIX O. VALERA

WITH FIVE TEXT FIGURES

The highest yield of dry fiber was obtained from plants harvested 123 days after planting. At this stage the plants which had 8 to 10 capsules were in full bloom and the bark ribbons could still be easily separated from the wood.

The fibers obtained from plants harvested 103, 113, and 123 days after planting had more or less the same softness, brightness, and luster. Those taken from plants over 123 days were dull brown and very coarse. The strongest fibers were produced by the 123-day-old plants; the weakest, by the 103- and 143-day-old plants.

Some farmers harvest kenaf for fiber when the first few flowers appear; others harvest the plants at later stages. It was expected that harvesting the plants at the right stage would result in increased yield and better quality of fiber. This study was therefore undertaken to determine the right stage for harvesting kenaf from May, 1955, to February, 1956, at the Central Experiment Station, College, Laguna.

MATERIALS AND METHODS

A fairly well-drained field of clay loam soil previously planted to corn was plowed twice with a disc plow and harrowed three times with a disc harrow. Twenty plots, each with an area of two square meters, were prepared. After the soil had been thoroughly pulverized, rows 20 centimeters apart were laid out.

The percentage of seed germination was determined under laboratory conditions. On May 11, 1955, 100 seeds [2] were sown in a properly prepared box. Seven days later, when germination was

[1] Central Experiment Station Contribution No. 1929. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, March, 1956. Prepared in the Department of Agronomy under the direction of Dr. Jose R. Mondoñedo.

[2] Seeds used were given by the Bureau of Plant Industry free of charge.

completed, the sprouted seeds were counted and the percentage of germination computed.

On June 19, 1955, tested seeds were planted five to eight to a hill, 10 centimeters between hills. When the plants were about 8 to 10 centimeters high, they were thinned to one plant to a hill.

The field was laid out in a randomized block design consisting of 20 plots, with four plots assigned to be harvested at a given maturity stage. The first harvest was designed to take place when the first flower bud had appeared (in this study 103 days after planting); the next four harvests were set at 10-day intervals between harvests.

When the plants were 11 days old, the plots were weeded and cultivated for the first time. Thereafter, weeding was done whenever necessary until the plants were so tall that getting in between the rows would have destroyed the plants. During this stage, only the spaces between the plots were weeded with a hoe.

One square meter of the plants at the center of each plot was cut at ground level during each harvest. The cut plants from each plot were tied in bundles and taken to the laboratory for weighing. The heights of 20 representative plants taken at random for each bundle were recorded, and the number of capsules were counted. The leaves were then removed and the bark ribbons separated from the wood, bundled, tagged, and then retted. Retting lasted for 13 days. The fiber was washed to remove the pulp and the gunny substance, and then it was dried in the sun and weighed. The relative fineness of the fibers was determined by feeling the fiber with the hand.

Twenty fiber samples were taken from each bundle for the tensile strength determination. Single fiber strands were tested on a Scott Tester IP-Tensilgraph machine.[3] The tensile strength in breaking length (km.) was computed by using the formula: of Botkin, Shires, and Smith:[4]

$$\text{Tensile Strength} = \frac{\text{Breaking load}}{\text{Weight of sample per 10 cm.}}$$

RESULTS AND DISCUSSION

Germination. Germination in the laboratory was 89 per cent. In the field, germination was completed in five to seven days. During

[3] The same instrument was used by T. B. Manzano, *Philippine Agriculturist*, 35, 561 (1952).

[4] C. W. Botkin, *et al.*, *New Mexico Agric. Exper. Sta. Bull.*, 300 (1952).

the early growth stage, the plants were green, vigorous and uniform in height.

Susceptibility to pests and diseases. The plants were attacked by *Nisotra gemella* Erichson and *Dysdercus megalopygus* Breddin,[5] but damage caused was not extensive.

Kenaf blight, *Phoma saddarifae* Sacc.,[6] was observed on the leaves of the plants, but damage caused was negligible.

Appearances of the plants at harvest. The first few flower buds appeared when the plants were 103 days old. It was at this stage when the flowers had not yet opened that the first harvest was done (fig. 1). Ten days later the second harvest followed. By this time the first buds had opened. On the average, there were one to two flowers in a plant (fig. 2). The third harvest took place when the plants were 123 days old. The plants were then in full bloom, and a plant had four to five flowers (fig. 3). Thirty days after the first harvest, the flowers that opened earlier started to wilt and drop, and the capsules were formed. The plants continued to increase in height. The leaves that developed were small so that the plants assumed a cone shape. Figure 4 shows the appearance of the plants harvested at 133 days. The last harvest took place when the plants were 143

TABLE 1.—*Description of the plants at harvest*

AGE IN DAYS	FLOWERS	NO. OF CAPSULES TO A PLANT
103	Appearance of the first flower bud	None
113	One to two flowers in bloom	1–2
123	Plants in full bloom	8–10
133	Flowers that opened earlier, wilted and dropped; the stem started to elongate; small leaves developed; flowers that opened were small	19–21
143	Color of lower capsules changed from green to yellowish brown; capsules formed were small	23–25

days old (fig. 5). Most of the leaves had dropped, and the lower capsules which used to be green had become yellowish brown.

Height of plants at harvest. The kenaf plants continued to grow until they began to shed their leaves. The last harvest had the tallest plants, and the first, the shortest (table 2). The difference in plant height between these two harvests was highly significant. The plants harvested at 133 days were also significantly taller than those harvested at 123, 113, and 103 days.

[5] Identified by Dr. Silverio Cendaña of the Department of Entomology.
[6] Identified by Dr. Faustino Orillo of the Department of Plant Pathology.

Fig. 1.—Appearance of plants harvested at 103 days old.
(*Photograph taken by the Photographic Division.*)

Fig. 2.—Appearance of plants harvested at 113 days old.
(*Photograph taken by the Photographic Division.*)

Fig. 3.—Appearance of plants harvested at 123 days old.
(*Photograph taken by the Photographic Division.*)

Fig. 4.—Appearance of plants harvested at 133 days old. (*Photograph taken by the Photographic Division.*)

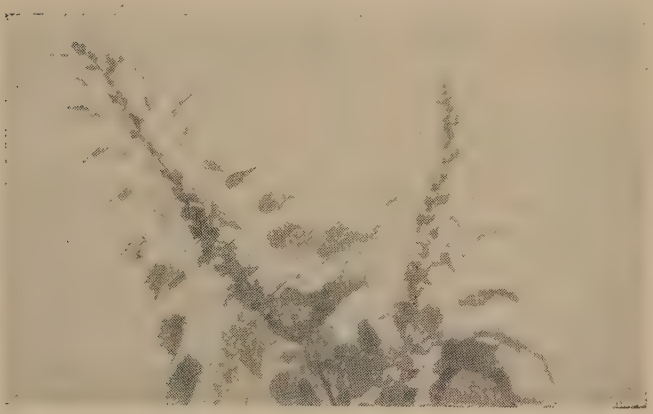

Fig. 5.—Appearance of plants harvested at 143 days old. (*Photograph taken by the Photographic Division.*)

No significant difference in height was noted between the plants harvested at 143 days and those harvested at 133 days.

TABLE 2.—*Height of plants in centimeters at harvest*

AGE OF PLANTS AT HARVEST	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
days						
103	231.2	236.7	230.6	245.2	943.7	235.9
113	259.3	254.7	236.0	273.0	1023.0	255.3
123	268.7	278.7	273.1	274.6	1095.1	273.8
133	302.1	299.2	297.4	310.2	1208.9	302.2
143	311.0	318.8	317.9	301.3	1249.9	312.4
Total	1373.2	1388.1	1355.0	1404.3	5520.6	

SMD at 5% = 13.44
SMD at 1% = 18.44

Comparative yield of fiber. The fiber production to a plant tended to increase from the time of the appearance of the first flower bud up to the full blooming stage (table 3). The yield of dry fiber was significantly higher in the third harvest (123 days) than in the first (103 days) and second (113 days) harvests. The difference in yield of dry fiber between the 123- and the 133-day-old plants was not significant.

TABLE 3.—*Weight of dry fiber from one-square-meter plots*

AGE OF PLANTS AT HARVEST	REPLICATION				TOTAL	MEAN
	I	II	III	IV		
days						
103	406	408	479	521	1914	478.5
113	541	611	576	567	2295	573.8
123	604	627	612	629	2473	618.0
133	602	614	600	621	2437	609.2
143	584	596	586	592	2358	589.3
Total	2737	2956	2853	2930	11476	

SMD at 5% = 32.90
SMD at 1% = 46.13

After the 123rd day, the bark became dry and could hardly be separated from the wood. Most of the inner fiber remained with the wood after separating the bark ribbons from the wood. Although longer fibers were obtained from the older plants, the increased length did not compensate for the large amount of fiber that remained with the wood. No significant differences in percentage of fiber extraction were found among the different harvests (tables 3 & 4).

TABLE 4.—*Percentage of fiber extraction based on fresh weight with leaves*

AGE OF PLANTS AT HARVEST	REPLICATION				TOTAL	MEAN [a]
	I	II	III	IV		
days						
103	3.70	4.30	3.90	4.69	16.59	4.19
113	4.10	4.43	4.06	4.08	16.67	4.18
123	4.37	4.83	4.57	4.43	18.10	4.50
133	4.34	4.26	4.29	4.25	17.14	4.26
143	4.17	4.06	3.97	4.17	16.39	4.09
Total	20.68	21.90	20.79	21.62	84.99	

[a] Insignificant

Comparative qualities of fiber obtained from plants harvested at different stages of maturity. The fibers from plants harvested at 103, 113, and 123 days had more or less the same softness, brightness, and luster. Those obtained from the fourth and the fifth harvests were dull brown and very coarse.

TABLE 5.—*Tensile strength of fiber in kilometers*

AGE OF PLANTS AT HARVEST	REPLICATION				TOTAL	MEAN [a]
	I	II	III	IV		
days						
103	5.85 [a]	5.80	5.40	5.40	22.45	5.61
113	8.97	9.04	8.87	8.92	35.80	8.95
123	8.62	10.86	10.24	9.99	39.71	9.93
133	8.77	8.81	8.78	8.89	35.25	8.81
143	7.78	7.60	7.87	8.00	31.25	7.81
Total	39.99	42.11	41.16	41.20	164.46	

[a] Average of 20 observations.
SMD at 5% = 0.83
SMD at 1% = 1.16

Table 5 shows the comparative tensile strength of the fibers in kilometers. The tensile strength of the fiber from plants harvested at 123 days was significantly higher than that from plants harvested 103, 113, 133, and 143 days after planting.

* * *

It is a common complaint that scientists are illiterate, that they express themselves badly and cannot write. There have been recent complaints that they do not buy books and presumably therefore don't read. Some at least of these criticisms should not be aimed at scientists alone but certainly ability to summarize data clearly, draw conclusions and express ideas is vital to both the scientist and the technologist.

—G. K. T. Conn

THE RESPONSE OF P. O. J. 3016 TO THE ADDITION OF NITROGEN, PHOSPHORUS, AND POTASSIUM [1]

SANTOS SOLDEVILLA GARRUCHO

In general, maturity of the cane did not vary in the different treatments except in some replanted canes.

The weight of tops and fresh leaves gave no significant variation between treatments.

The 45 kg. N (added singly or in combination with P and K) gave an average increase of 44.88 piculs sugar and the 90 kg. N, 67.69 piculs sugar per hectare over the non-fertilized.

One way of lowering the cost of production of sugar cane in the Philippines is the application of the right kind and amount of fertilizers to give the highest possible yield of sugar. The sugar produced per hectare is the product of cane tonnage and per cent sucrose content of the cane. An increase in either cane yield or sucrose content means higher production. Increase in cane tonnage with no increase in piculs sugar per hectare may give an increase in cost of handling and hauling of the cane; however, an accompanying increase in sucrose content of the cane means a lower cost of production and profit.

To determine the response of P. O. J. 3016, a sugar-cane variety, to the addition of fertilizers this study was conducted from June, 1955, to February, 1956.

In the fertilization of sugar cane, both tonnage and sucrose concentration must be given due consideration. Increase in cane tonnage by the use of fertilizers is useless if accompanied by a decrease in sucrose concentration.

Locsin and Tabayoyong (1953) reported that the heavy tonnage of cane obtained from heavily limed plots receiving different fertilizer treatments was accompanied by low piculs of sugar per ton cane, so that the resulting yield in piculs of sugar was not signifi-

[1] Central Experiment Station Contribution No. 1930. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, June, 1956. Prepared in the Departments of Soils and Agronomy under the direction of Drs. Nicolas L. Galvez and Valeriano C. Calma.

cantly higher than those obtained from plots receiving lighter or no lime application.

In the five sugar districts (Pasudeco, Del Carmen, Tarlac, Paniqui, and Don Pedro) in Luzon, the main problem is low tonnage and poor quality ratio of the existing crop. According to Villareal *et al.*[2] this problem may be due to the planting of obsolete sugar cane varieties and to the farmers' ignorance of the advantageous use of lime to correct soil acidity and the use of fertilizers to replace the plant food elements drained out every year by cropping, leaching, and erosion.

In Puerto Rico, Samuels *et al.* (1952) reported that nitrogen more than any other fertilizer is responsible for increase in cane tonnage.

In Louisiana, according to Mirasol (1954), nitrogen in the form of ammonia is applied at the rate of 34 to 45 kilograms per hectare for plant cane, and 90 kilograms for the ratoon. Where aqua ammonia is used, 45 to 56 kilograms of nitrogen per hectare are applied to plant cane, and 67 to 90 kilograms to ratoons.

The results of 144 field experiments made by Samuels *et al.* (1954) showed that in general, there was very little difference in yield of cane attributable to phosphorus, the response on the average being less than a 10-per cent increase. The majority of the increases in percentage sucrose lie within a -6 to $+3$ range. Although there was a decrease in sucrose content, there was no decrease in ton of cane. Where large increases in ton of cane were encountered (over 10%), the response of phosphorus in per cent sucrose was inconsistent. A reduction in the sucrose content of cane grown in phosphorus-nutrient solutions was observed.

Samuels *et al.* found no significant difference in sucrose concentration attributable to potassium fertilizers. In general, the response in yield from potash application was low. Majority of the increases in tons of cane per acre were less than 10 per cent. They reported that although majority of the sucrose increases were positive, there was no significant relationship between the application of potash and sucrose concentrations.

The use of minor-element fertilizers on sugar-cane soils in Puerto Rico produced no general significant increase in the sucrose content and on cane tonnage. Magnesium, manganese, and zinc

[2] Unpublished observations of E.P. Villareal, P. G. Dayrit, J. Cajigal and M. R. Pegenia of the Philippine Sugar Institute.

produced both negative and positive responses in sucrose concentration. Copper gave increases in sucrose in four experiments; boron showed four positive responses and 1 negative response in five experiments. The application of sodium did not produce any definite positive response in sucrose content. Iron and sulfur showed an increase in sucrose content. The results with calcium were inconsistent from the standpoint of increase in sucrose. The limed soils used had a pH above 6.2.

Mirasol reported that the determination of available plant foods in the soil using a weak-acid extraction was used as a basis for formulating fertilizer requirements of soils. Chemical analysis supplemented by repeated field trials may establish a reliable basis for a sound fertilizer practice for certain types of soil.

Foliar diagnosis which involves the chemical analysis of leaf tissues for nitrogen, phosphorus, potassium, calcium, and magnesium, and its final correlation to fertilizer needs received recent attention in assessing the fertilizer needs of sugar cane in the work of Locsin and Guillermo (1954).

MATERIALS AND METHODS

A 960-square-meter field of Lipa clay loam [3] was used.

This field which had received ammonium sulfate and super-phosphate fertilizers during the previous croppings was divided into thirty-two 3 × 10-meter plots. There were three 10-meter rows in each plot. Eight treatments and four replications were made in a completely randomized block design. The plots were marked by sticks with corresponding labels.

Land preparation was done first with tractor-mounted plows and later with disc harrows. Alternate plowing and harrowing of the field was done twice in November and December, 1954.

One-meter spaced furrows were made with a furrower mounted in a tractor. Sugar-cane seed pieces, variety P.O.J. 3016, were planted on December 15, 1954.

A composite sample of the upper twelve-inch layer was analyzed in the field to determine its fertility level by color comparison with brom thymol blue or phenol red as indicator, and later in the laboratory by using a Bechman pH meter. This soil had a pH of 5.6. The organic matter content, available phosphorus and potassium, ca-

[3] A portion of the seven-hectare sugar-cane land of the Philippine Sugar Institute in Sto. Tomas, Batangas.

tion exchange capacity, exchangeable calcium, and manganese were determined according to the method of Peech *et al.* (1947).

Off-barring was done with a native plow on June 18, 1955, to kill the weeds between the rows. Thereafter, occasional weeding between the furrows and around the hills was done with grub hoes and weeding bolos.

Replanting of the vacant or missing hills was done on June 25, 1955. Since there were no planting materials available at that time, the materials used were taken from hills with a good number of tillers. Drought and other adverse conditions, however, killed some of the replanted canes.

The fertilizer treatments applied as top dressing are given in table 1, first column. Nitrogen was supplied as ammonium sulfate (20% nitrogen); phosphorus, as superphosphate (18% P_2O_5); and potassium, as muriate of potash (60% K_2O).

TABLE 1.—*Kind and amount of fertilizer per replicate*

TREATMENT	N-P-K Kilograms per ha.	KILOGRAMS OF FERTILIZER PER HECTARE		
		Ammonium sulfate	Superphosphate	Muriate of potash
1	0– 0– 0 (Control)	0	0	0
2	45– 0– 0	225.00	0	0
3	90– 0– 0	450.00	0	0
4	45–60– 0	225.00	333.33	0
5	45–60– 60	225.00	333.33	100.00
6	90–60– 60	450.00	333.33	100.00
7	45–60– 90	225.00	333.33	150.00
8	45–60–120	225.00	333.33	200.00

Final cultivation and hilling was done on July 29 and 30, 1955, by using a native plow passed three times between the rows.

Percentage stand was determined by counting the missing hills in every plot about six months after planting, too months after replanting, and about a month before harvesting. The color, average height, vigor and general appearance of the plants were observed. Plants that were destroyed by pests and diseases were also noted.

Crop maturity was determined by means of a hand refractometer. The middle row of every plot was harvested, one-half meter on both ends as buffer.

The weights of millable canes and tops and fresh leaves were determined by means of the Fairbank balance. From these data,

the weights in tons of millable canes, tops and fresh leaves, and cane destroyed were calculated per hectare.

Twenty-five millable stalks were taken at random from the middle row of every plot and were brought to the College for milling and juice analysis.

Each cane stalk was cut into three pieces and each piece was divided lengthwise into two; one-half was used as sample and the other half was discarded. The samples were milled in a small cane-crusher which was attached to a one-horsepower electric motor.

The juice was brought to the Department of Chemistry laboratory for the determination of the Brix and polarization.[4] Percentage pol (sucrose), apparent purity, and piculs sugar per ton cane were determined. The yield in piculs sugar per hectare was calculated from the tons cane per hectare and piculs sugar per ton cane.

EXPERIMENTAL RESULTS AND DISCUSSION

Soil Analysis. The chemical analysis of the soil sample is shown in table 2. The soil has a pH of 5.6, and an available calcium content of 17.01 m.e. per 100 grams of soil which is equivalent to 6804 kilograms of calcium per hectare. The amount of available phosphorus which is equivalent to 57.5 parts per million is fair enough for the growing cane. The potassium content is 1.27 m.e. per 100 grams of soil. The amount of organic matter is quite high. The results of the analysis further show that this soil needs lime to correct the acidity to about pH 6-7 which is the optimum for sugar cane plants.

TABLE 2.—*Chemical analysis of the soil*

pH	5.6
Organic matter	3.29%
Available phosphorus	57.5 ppm
Cation exchange capacity	31.88 m.e. per 100 gm. soil
Calcium [a]	17.01 m.e. per 100 gm. soil
Potassium [a]	1.27 m.e. per 100 gm. soil
Magnesium [a]	6.00 m.e. per 100 gm. soil
Manganese [a]	0.01 m.e. per 100 gm. soil

[a] These represent 3,402, 497, 730 and 2.7 ppm of calcium, potassium, magnesium and manganese, respectively.

[4] Under the direction of Professor L. J. Villanueva.

Field observations. The low mean stand of 69.1% six months after planting in overall treatments can be attributed to inadequate moisture for germination at planting time. Two months after replanting the stand was 94.4%, but due to drought and other adverse conditions most of the replanted canes died. Hence, the average stand at harvest time was only 85.3%.

The highest mean percentage stand before harvest was shown by treatment 45-0-0 and the lowest, by 45-60-60. They were 94.3% and 80.8%, respectively.

The number of millable stalks were affected by storms, rats, sugar cane smut and those purposely cut by unknown persons. The storms in September, 1955, and from November 24 to December 3, 1955, caused much damage to the sugar cane.

Sugar cane wooly aphid, *Ceratovacuna lanigera* Sehnter, was rampant from August to November. According to Uichanco and Sacay (1949), this pest sucks the plant sap causing the plant to lose vigor; hence, the amount of sucrose content in the juice is affected. Its presence was also accompanied by the growth of a sooty mold on the leaves which interferes with normal photosynthesis. This pest was destroyed by hand crushing.

Gray borer of sugar cane, *Oleuthreutes schistaceana* Snellen, may partly account for the death of most young tillers.

Some young stalks of the cane were attacked by top borers, *Topeutis auriflua* Zeller and *T. intacta Snellen.* The larva bored through the growing portion of nearly mature sugar canes and fed on the other plant tissues. The growth of the infested canes was arrested, the leaves became successively shorter, and a row of holes were found in the growing portion either on the node or internode. Moth stalk-borers, *Distracea venogata* Walker, and *Sesamie inferens* Walker are believed to have bored holes on the stalks of the sugar cane.

Canes attacked by sugar-cane smut, caused by *Ustilago scitaminea* (Rabh.) Syd., were uprooted and burned to avoid infection of the other healthy plants.

Other minor diseases that affected the sucrose content of the cane were yellow spot (*Cercospora kopkei* Kr.) and red rot (*Physalospora tucumanensis* Speg.-*Colletotrichum falcatum* Went.) of sugar cane.[5]

[5] Examined and identified by Mrs. Victoria M. Ela of the Department of Plant Pathology.

In general, most of the replanted canes, especially the control, were stunted in growth and had slender stalks and very low tillering. A number of the replanted canes did not reach maturity but some of those in the 90-0-0 and 90-60-60 treatments were able to recover after the application of the fertilizers.

The height of the cane at maturity was measured from the base of the plant to the tip of the furled leaf. Fertilizers and favorable moisture and temperature accounted for the rapid growth of the plants 22 days after the application of fertilizers (July 9, 1955). In general, the plants in the control were much shorter and slender than those in the other treatments. About harvest time, the plants in the 90-0-0 treatment were the tallest, followed by those in the 45-60-120 treatment (table 3, column 2).

Treatments 90-0-0 and 90-60-60 had more tillers than the other treatments and the control. However, the plants in the 90-0-0 treatment had better growth, vigor, and tillering than those in the 90-60-60 treatment. In replication II of the 90-0-0 treatment, about 50 per cent of the plants were attacked by wooly aphids; hence, a low percentage stand was obtained.

The highest number of millable stalks destroyed was shown by 90-0-0 and the lowest by 0-0-0. From this it may be inferred that high rate of nitrogen alone made the cane plants more susceptible to destruction. Treatment 90-60-60 showed a mean destruction of only 13.75 stalks while 90-0-0, 19.75 stalks (table 3, column 3).

SUMMARY TABLE

TABLE 3.—*Effect of nitrogen, phosphorus, and potassium on mean height, tonnage, and sugar yield of POJ 3016*

TREATMENT	MEAN HEIGHT AT MATURITY (centimeters)	MEAN NUMBER OF STALKS DESTROYED	TONS CANE PER HECTARE	PICULS SUGAR PER TON CANE	PICULS SUGAR PER HECTARE
1	2	3	4	5	6
0– 0– 0	335.7	8.75	49.67	2.135	105.96
45– 0– 0	366.2	15.25	70.28	2.293	160.51
90– 0– 0	373.1	19.75	89.22	2.015	180.34
45–60– 0	367.2	15.00	69.61	2.171	150.84
45–60– 60	360.1	13.50	65.83	2.155	148.61
90–60– 60	368.5	13.75	79.61	2.097	166.96
45–60– 90	368.4	15.25	63.95	2.345	150.57
45–60–120	371.8	13.50	61.00	2.349	143.69
S.M.D. at 5% (T)		—	16.54	0.17	41.75
S.M.D. at 1% (T)		—	22.51	0.23	—

Maturity of the crop. Small samples from the base, middle, and top portions of the stalk were extracted by means of a juice extractor and each sample was inserted in the refractometer. The reading was equivalent to the percentage sucrose in cane. The cane was considered mature when the refractometer readings of the base, middle, and top portions of the stalk were almost the same. At maturity the base of the stalks gave a mean reading of 21.19, the middle portion, 20.33, and the top, 19.04. Refractometer readings increased with the amounts of K_2O added. The plants under the different treatments matured at about 11 months after planting.

Tons cane per hectare. Data obtained on the actual yield of cane per hectare show that the treatments had a highly significant effect (table 3, column 4). There was a significant increase in tonnage of cane when 45 kilograms of nitrogen alone was applied; when this was doubled, a highly significant increase over the 45-kilogram-nitrogen per hectare was obtained. No effect on yield was obtained with the addition of 60 kilograms of phosphorus per hectare to the 45-0-0 treatment. The 90-60-60 treatment gave a highly significant increase over that of the control, but was no better than the 90-0-0 treatment. The addition of 60 kilograms of potash to the 45-60-0 treatment, had no effect on the yield. Treatment 45-60-0 gave a slight decrease in yield over that of the 45-60-60 treatment. In comparing the 45-60-60 treatment with that of the 90-60-60 treatment, the latter gave an increase of more than 10 tons of cane per hectare due to an increase in the amount of nitrogen. The 45-60-120 treatment gave a decrease in yield from the 45-60-90 treatment. On the whole, the cane yield response was due to added nitrogen and not to either phosphorus or potassium.

Piculs sugar per ton cane. The analysis of the sugar cane juice from plants of the different treatments shows that treatments 45-60-90 and 45-60-120 apparently had higher Brix (soluble solids), per cent pol (% sucrose in cane), apparent purity, and piculs of sugar per ton cane compared to the other treatments and the control. Although these two treatments had higher apparent purities and piculs of sugar per ton cane (table 3, column 5), there was no significant increase in the yield of sugar to a hectare due to low tonnage in cane per hectare compared to the other treatments. The mean juice for the Brix was 20.30; for per cent pol, 18.33; for apparent purity, 90.24; and the piculs sugar per ton cane was 2.21. Treatment 90-0-0 had a lower piculs sugar per ton cane compared to the other treatments including the control but this slight difference did not

affect the yield in piculs sugar per hectare because of its high tonnage in cane per hectare.

Piculs sugar per hectare. Data in the yield of piculs sugar per ton cane indicate a significant effect of the treatments (table 3, column 6). The yield of sugar in piculs per hectare showed no significant effect of the treatments. Treatment 90-0-0 gave the highest yield of sugar per hectare with 180.34 piculs; the control had the lowest with 105.96 piculs. Treatment 45-0-0 gave an increase of 54.55 piculs over that of the control. Treatment 90-0-0 gave an increase of 74.38 piculs over that of the control, but only 19.83 piculs over the 45-0-0. The average increase of the 45-kilogram nitrogen series (added singly or in combination with phosphorus and potassium) was 44.88 piculs, and that of the 90-kilogram series, 67.69 piculs.

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I have no faith in anything short of actual measurement and Rule of Three.

—*Charles Darwin*

MARASMIUS STEM ROT OF SUGAR CANE [1]

GIL G. DIVINAGRACIA

WITH FIVE TEXT FIGURES

The Marasmius stem rot of sugar cane caused by *Marasmius sacchari* Wakker primarily attacks the leaf sheaths and is prevalent during the rainy season. The lesions on the leaf sheaths are irregular, reddish-orange to reddish at first and later turning brown to dark brown with age. The most reliable symptom of the disease is the cementing of the older leaf sheaths to the main stalk by the whitish mycelium of the fungus. Under favorable conditions, mushroom-like fructifications are usually produced at the base of the plant.

The causal organism grows profusely on most agar media and substrates and at a wide pH range. No sporophore was produced when the fungus was subjected to different conditions and when grown on the different media and substrates. The mycelium, which serves as a means by which the fungus lives over adverse conditions, remains viable for as long as 10 months on potato-dextrose agar and for about 7 months in the diseased leaf sheaths. All the varieties inoculated were attacked although they differed slightly in their susceptibility. Cross-inoculation experiments showed that the fungus could attack several other species. The fungus could attack plants without previous wounding. In the field, it may be disseminated chiefly by the mycelium and rarely by basidiospores.

The disease may be controlled by sanitation, good tilth, planting less susceptible varieties and using fungicides like Dithane D-14 and Orthocide 50.

The Marasmius stem rot of sugar cane although a minor disease merits attention since its presence in the field causes low yield.

This study designed to contribute to our knowledge of the disease, its cause, and possible control was conducted from December, 1954, to February, 1956, in the Department of Plant Pathology and in the sugar-cane fields of the College of Agriculture and vicinity. The work was divided into the (1) study of the disease in the field and in the laboratory, (2) study of the morphological and physiological characteristics of the causal fungus, and (3) formulation of control measures.

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[1] Central Experiment Station Contribution No. 1931. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, March, 1956. Prepared in the Department of Plant Pathology under the direction of Dr. Faustino T. Orillo.

GEOGRAPHICAL DISTRIBUTION OF THE DISEASE

The occurrence of Marasmius stem rot of sugar cane in the Philippines was first reported by Copeland in 1917. Ocfemia (1939) reported Marasmius sheath rot but made no mention of the relationship between the two diseases. Rosenfeld (1939) listed root rot associated with *Marasmius* species and *Marasmius sacchari* on old leaf sheaths and rhizomes in his report on the minor sugar-cane diseases in Egypt. This disease or very similar ones are also reported present in Hawaii, Fiji, Australia, Java, India, Mauritius, Louisiana, Cuba, Puerto Rico, British West Indies, Argentina, Brazil, Japan, and other sugar cane-producing countries.

The disease was observed on very few plants in the vicinity of the College and on several varieties propagated in the Canlubang Sugar Estate.

SYMPTOMS

Marasmius stem rot of sugar cane manifests itself as an irregular reddish-orange to reddish discoloration which advances vertically faster on the lower leaf sheaths than around the stem. As the disease progresses, the lesions gradually become darker in color and finally turn brown to dark brown. Sometimes the leaf sheaths crack and split and the areas between the split portion and the sides of the sheaths are covered with whitish mycelium. At this stage, the mycelium cements the leaf sheath to the stem (fig. 1). When the leaf sheath is removed, another reddish discoloration is observed in the inner sheath. The mycelium may be seen scattered on this portion and also on the inner side of the older leaf sheath. Meanwhile, the leaf borne by the infected leaf sheath gradually becomes yellow, droops and dies.

The fungus may cover the entire length of the leaf sheath. In the advanced stage of the disease, the leaf sheaths are so pasted that it requires some effort to separate them from the main stalk. Sporophores may appear on the attacked portions usually at the base of the stalk.

The diseased plant becomes stunted and produces shoots at the base which, under favorable conditions, may also be attacked.

THE CAUSAL ORGANISM

The causal fungus was isolated from old and newly attacked sugar-cane leaf sheaths. The diseased tissues were first washed tho-

Fig. 1.—Inoculated (right) and control (left) sugar-cane plants one week after inoculation. Inoculation was done by smearing the stems with mycelium together with a portion of the medium. Control plant was smeared with agar alone. Note discoloration at the point of inoculation in the inoculated plant. (*Photograph taken by the Photographic Division*).

roughly with distilled water, plated in acidified potato-dextrose agar, then incubated at ordinary room temperature. After three days, when growth was abundant, transfers were made from the resulting mycelial growth to agar slants. Subcultures made from these transfers were used in the inoculation experiments and in the morphological studies.

MORPHOLOGY

Mycelium. The fungus produces abundantly both submerged and aerial mycelium on most agar media and sterilized plant tissues. The hyphae are hyaline, thick-walled, finely granular when young and become finer and clearer when old. Measurements of 200 hyphal cells from three-day-old potato-dextrose agar block cultures show that the cells are from 43.38 to 159.50 microns in length and 0.26 to 6.38 microns in width, with an average size of 93.57 $\pm$ 1.70 x 3.32 $\pm$ 0.10 microns.

The mycelium branches either at right or acute angles. The main hypha, which is quite big, branches into smaller hyphae which

in turn branch into finer hyphal cells. Septa are generally found in clamp connections of varying forms (fig. 3a). One to three branches often arise from these clamp connections.

Sporophores. The sporophores are generally grouped together although they may also be scattered (fig. 2). At first they appear as undifferentiated small whitish protrusions which gradually take a mushroom-like form. They are white when young, become brownish after reaching maturity, and finally dry up. In the field they are mostly found at or near the base of the stem. In the damp chamber some were observed on the upper part of the stem near the shoot and on some parts of the roots. Those produced in the field are smaller than those in the damp chamber.

Fig. 2.—Sporophores of the fungus produced in the damp chamber. (*Photograph taken by the Photographic Division*).

a) *Stipes.* The stipes are white, smooth, cylindrical, and centrally located at the pileus. They are slightly enlarged at the point of attachment to the plant. Measurements of 36 specimens produced in the damp chamber show that they vary from 8 to 23 mm. long, with an average of 16.26 mm.

b) *Pileus.* The pileus is white, campanulate when young and sometimes becomes funnel-shaped when old. The diameter ranges from 7 to 29 mm., with an average of 12.45 mm.

The *gills* are white, generally arising from the center of the pileus and radiating towards the tip. Some gills, however, radiate towards the center from the tip of the pileus, although they grow only a short distance from the tip. These usually fill the space between the two radiating gills.

The *basidia* are cylindrical, clavate, and granular (fig. 3b). They vary from 22.50 to 38.69 microns in length and 4.31 to 9.40 microns in width; the average size is 30.55 ± 0.23 x 6.88 ± 0.06 microns.

The *sterigmata* are pointed with an enlarged base, hyaline, four in number, although occasionally they may only be two or three (fig. 3b). Measurements of 100 sterigmata show that they vary from 2.9 to 3.36 microns long, with an average length of 3.89 ± 0.05 microns.

The *basidiospores* are irregularly oblong, straight or slightly curved, hyaline, non-granular, thick-walled, and attenuate at the point of attachment to the sterigmata (fig. 3c). Measurements of 200 basidiospores showed that they vary in size from 6.03 x 2.26 microns to 13.97 x 5.26 microns, with an average size of 10.26 ± 0.09 x 3.63 ± 0.03 microns.

PHYSIOLOGY

Growth of fungus on various agar media and substrates. The growth and cultural characteristics of the fungus were studied on various agar media, namely, potato-dextrose agar, potato-sucrose agar, nutrient agar, nutrient-dextrose agar, onion agar, bean agar, malt agar, corn meal agar, Czapek's agar and water agar. Triplicate plate cultures were made for each medium using mycelium from an 8-day-old culture as inoculum. The plates were kept under ordinary room temperature. Measurements of the diameter of the mycelial growth were made from the second to the fifth day, after

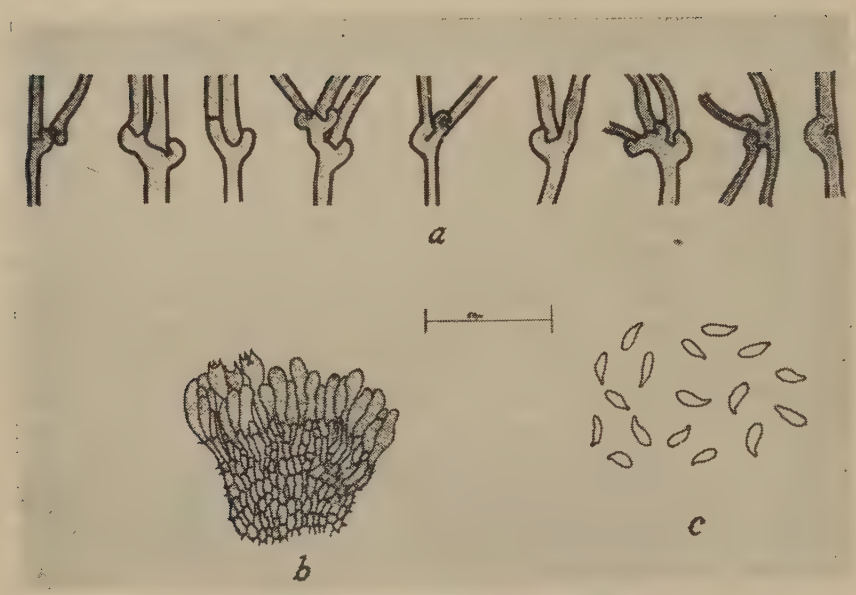

Fig. 3.—Camera lucida drawing of *Marasmius sacchari*. a—Mycelium showing different forms of clamp connections. b—Basidia and sterigmata. c—Basidiospores. (*Photograph taken by the Photographic Division*).

the plates were inoculated. The cultures were then observed for three more weeks for any possible sporophore production. Results are summarized in table 1.

The fungus grew best on potato-dextrose agar, potato-sucrose agar, and onion agar. In these media both the surface and aerial mycelia were abundant, the latter exhibiting a fluffy or feathery growth. On malt agar the rate of growth was the same as on potato-dextrose agar, potato-sucrose agar, and onion agar but the aerial mycelium was less abundant (fig. 4). The fungus also produced very abundant aerial mycelium on bean agar although growth was slower than that on the previous four media. The growth on nutrient-dextrose agar was comparable to that on bean agar but scarce aerial mycelium was observed. However, a thick mycelial growth was produced on the surface of the medium. A very scarce but fast growth was observed on corn meal agar. The fungus grew very slowly and very scarcely on Czapek's agar and nutrient agar. Growth was very limited on water agar. No sporophores were produced on any of the media even after one month of observation.

TABLE 1.—*Growth characteristics and sporophore production of Marasmius sacchari on various agar media*

MEDIUM	GROWTH CHARACTERISTICS	PRODUCTION OF SPOROPHORE	DIAMETER OF COLONY AFTER FIVE DAYS	AVERAGE DAILY GROWTH
			mm.[a]	*mm.*
Nutrient agar	Scarce, white to dull white mycelium produced within 24-48 hours; culture medium changed from pale brownish drab to light cinnamon drab.	None	83.00	18.33
Nutrient-dextrose agar	Fairly abundant, white mycelium produced within 2-3 days; culture medium changed from light vinaceous-fawn to vinaceous buff.	None	19.66	17.33
Potato-dextrose agar	Very abundant, white mycelium produced within 24-48 hours; culture medium changed from pale pinkish buff to pinkish buff.	None	93.00	18.89
Potato-sucrose agar	Very abundant, white mycelium produced within 24-48 hours; culture medium changed from pale pinkish buff to neutral gray.	None	92.00	20.56
Onion agar	Very abundant, white mycelium produced within 24-48 hours; culture medium changed from pale olive buff to neutral gray.	None	93.00	20.56
Bean agar	Abundant, white mycelium produced within 2-3 days; culture medium changed from cinnamon-rufous to ochraceous-orange.	None	80.00	18.22
Malt agar	Very abundant, white mycelium produced within 2-3 days; culture medium changed from light cinnamon drab to cinnamon drab.	None	89.66	20.66

[a] Average of three cultures.

TABLE 1 (continued)

MEDIUM	GROWTH CHARACTERISTICS	PRODUCTION OF SPOROPHORE	DIAMETER OF COLONY AFTER FIVE DAYS	AVERAGE DAILY GROWTH
			mm.[a]	*mm.*
Corn meal agar	Scarce, white to neutral gray mycelium produced within 24-48 hours; culture medium changed from pale brownish vinaceous to pale pinkish buff.	None	79.50	16.55
Czapek's agar	Scarce, white to dull white mycelium produced within 2-3 days; culture medium changed from pallid neutral gray to carbon gray.	None	65.50	13.66
Water agar	Very scarce, dull white to neutral gray mycelium produced within 2-3 days; culture medium did not change color.	None	66.66	16.22

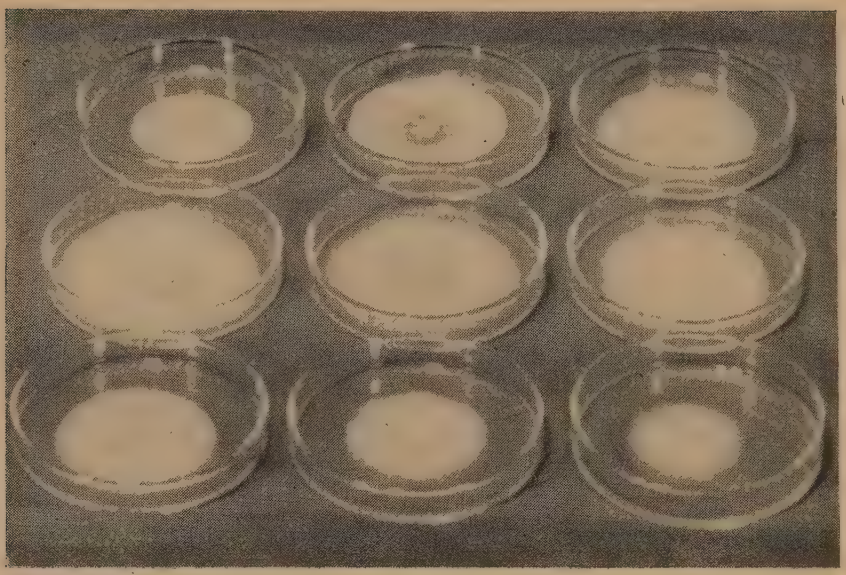

Fig. 4.—Growth of *Marasmius sacchari* on various agar media after five days. From left to right, first row, potato-sucrose agar, onion agar and malt agar; middle row, potato-dextrose agar, bean agar, nutrient dextrose agar, and nutrient agar; lower row, corn meal agar, Czapek's agar and water agar. (*Photographed by Olive's Studio, Junction, College, Laguna*).

The substrates used to grow the fungus were sugar-cane leaf, sugar-cane leaf sheath, sugar-cane shoot, sugar-cane stem, Irish potato, sweet potato, yambean, and gabi cylinders. Triplicate test tube cultures were used for each substrate. The fungus mycelium was transferred to the center of each substrate and later incubated under ordinary laboratory conditions. Daily observations were made until the mycelium covered the substrates. From then on, the cultures were observed for possible sporophore production.

Growth was quite fast on all the substrates used. The rapidly growing mycelium completely covered the substrates on the fourth day after inoculation. On sugar-cane leaf and leaf sheath, growth was thin, but on all the other substrates, the fungus produced profuse, white and fluffy mycelium. No sporophore was produced even after a month's observation.

Growth of fungus on media of varying hydrogen-ion concentrations. The fungus was grown on potato-dextrose agar at different pH levels to determine the effects of the different hydrogen-

ion concentrations on mycelial growth. The pH of the agar medium, which ranged from 2.0 to 11.0, was adjusted by either the addition of one-tenth normal NaOH or one-tenth normal HCl. The pH readings were determined by means of the La Motte colorimeter. Triplicate cultures were made for each pH level and kept at ordinary room temperature. The diameter of the mycelial growth was measured after the second, third, fourth, and fifth days. Measurements were taken only up to the fifth day because the growth was so fast under the favorable pH conditions that the mycelium almost covered the entire agar medium. Final determination of the relative abundance of the mycelium was made on the sixth day.

The results of the experiment are summarized in table 2. The fungus grew very well at a pH range of 3.0 to 8.0. At pH 9.0 and 10.0, growth was a bit slower. Very slow growth occurred at pH 2.0 and 11.0, although mycelium was more compact at 11.0. The best growth was observed at pH 5.0 and 6.0 where the mycelium grew very abundantly and quite uniformly. The differences in mycelial growth at pH 4.0, 5.0, and 6.0 were slight. The size of colony was almost the same at pH 7.0 and 8.0 and also at pH 9.0, 10.0, and 11.0. Mycelial growth was also observed to be more feathery or fluffy and more compact on the alkaline side (fig. 5). No sporophore production was observed.

TABLE 2.—*Growth of Marasmius sacchari on potato-dextrose agar of different hydrogen-ion concentrations*

pH OF MEDIUM	DIAMETER OF COLONY AFTER FIVE DAYS [a]	AVERAGE DAILY GROWTH	RELATIVE ABUNDANCE OF MYCELIUM
	(*mm.*)	(*mm.*)	
2.0	64.00	14.83	Fairly abundant
3.0	77.00	17.44	Abundant
4.0	81.66	19.66	Abundant
5.0	88.00	20.23	Very abundant
6.0	88.00	20.44	Very abundant
7.0	78.00	18.45	Abundant
8.0	77.66	18.33	Abundant
9.0	58.66	15.33	Fairly abundant
10.0	56.66	13.32	Fairly abundant
11.0	52.33	11.77	Scarce

Methods of inducing growth of fungus and sporophore production. To induce sporophore production, and to observe further

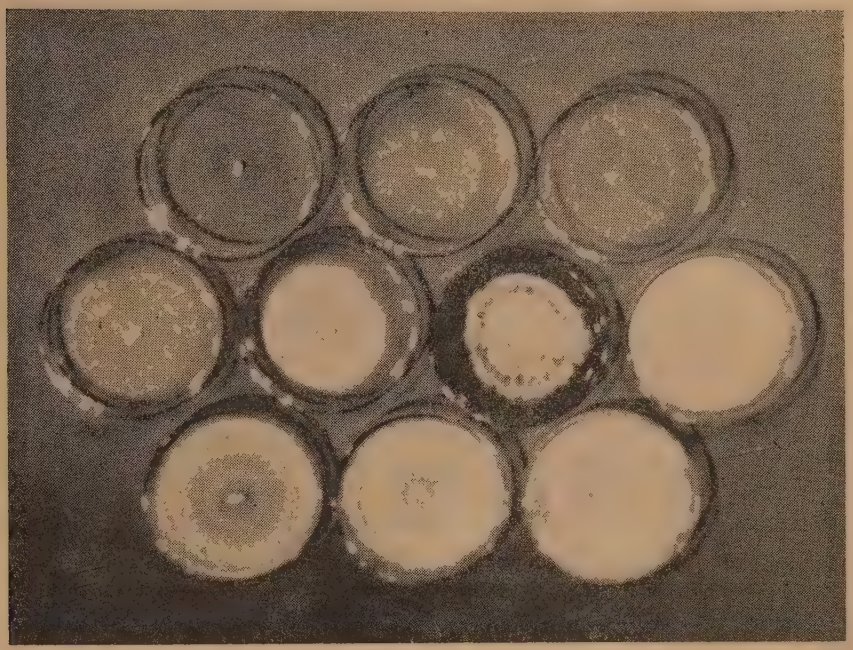

Fig. 5.—Growth of *Marasmius sacchari* after five days on potato-dextrose agar with pH ranging from 2.0 to 11.0. Left to right, upper row, pH 2.0, 3.0 and 4.0; middle row, pH 5.0, 6.0 and 7.0; lower row, pH 8.0, 9.0 and 10.0. (*Photographed by Star Studio, Junction, College, Laguna*).

growth of the fungus, five methods were tried. Triplicate cultures were made for each treatment, and in every case a control was provided.

1) Growing the fungus in a desiccator—Agar slant cultures were placed in a desiccator for a week. After that period they were kept under ordinary room conditions for observation.

2) Exposure of cultures to low and high temperature—Slant cultures were placed in a freezer at −4°C and another set of cultures in an incubator at 37°C for one week.

3) Exposure of cut mycelium to sunlight—The fungus mycelium, together with the agar media, was aseptically cut into small blocks about one centimeter square each. They were exposed for 8 hours to the sun from 8 a.m. to 4 p.m. and later incubated in the laboratory.

4) Treating the cultures with dilute solutions of poisonous substances—Cultures grown in 100-ml. flasks were treated with three to

four drops of chloropicrin, phenol and formaldehyde. These solutions were spread throughout the cultures by shaking them thoroughly. After the treatment, they were placed under ordinary laboratory conditions.

5) Alternate exposure of cultures to light and dark—Cultures in 100-ml. Erlenmeyer flasks were placed in a black-painted box with a 50-watt bulb inside. The cultures were exposed to three-hour alternate light and dark conditions for 48 hours. Temperature inside the box was around 38°C.

All these treatments did not induce sporophore production by the fungus. On the other hand, growth varied with the different treatments. The cultures placed in the desiccator grew as fast as those kept under ordinary laboratory conditions. However, growth was arrested about 1 cm. from the tip of the slant near the mouth of the test tube. The mycelium was much finer and fluffier. Cultures subjected to low temperature and those treated with dilute solutions of poisonous substances were greatly inhibited, whereas those placed in the incubator grew normally and appeared finer than the control. The culture with cut mycelium exposed to the sun was first slightly inhibited, but after two days under ordinary room conditions, abundant aerial mycelium was produced within the blocks. Growth of those exposed to alternate light and dark were markedly slowed down during the treatment but two days after, normal growth was resumed.

Viability of mycelium. The viability of the mycelium was tested in the laboratory by making monthly transfers to fresh agar slants and by pouring liquid agar media on old cultures. Results of these experiments showed that the mycelium remained alive for ten months. The mycelium in the diseased tissues was also observed. Dead inoculated plants were placed outside and from them, monthly isolations were made. The mycelium in this case retained its viability for seven months.

TAXONOMY

The fungus-causing stem rot of sugar cane closely resembles *Marasmius sacchari* Wakker. A comparison of its morphological characteristics with other species of *Marasmius* known to attack sugar cane shows that it is much closer to *M. sacchari* described by Saccardo (1884) and Matsumoto (1952). The symptoms and effects produced by this fungus on sugar cane are also similar to those

reported in other places. There are, however, differences in measurements reported by previous workers. For example, Saccardo's measurements of the basidiospores are from 16 to 20 x 4 to 5 microns; Matsumoto's, 6 to 12 x 4 to 6 microns. Measurements made by the writer are from 6.03 to 13.0 x 2.26 to 5.26 microns. The differences may be attributed to variations in climatic conditions and conditions prevailing during sporophore production.

PATHOGENICITY

Experiment 1. On May 31, 1955, three potted 3-month-old sugar-cane plants were inoculated by smearing 5-day-old mycelium, together with the portion of the media, on the stem just above the soil level. These and the control plants which were smeared with sterilized agar alone were placed in the damp chamber for 48 hours and later transferred outside for further observation. After 48 hours in the damp chamber, symptoms of the disease appeared on the inoculated plants. These symptoms continued to develop after the plants were transferred outside. No symptoms developed in the control plants.

Experiment 2. On May 31, 1955, three potted 3-month-old sugar-cane plants were sprayed with a suspension of mycelial fragments in distilled water. The inoculum was taken from five-day-old cultures. The control plants were sprayed with distilled water. The inoculated and the control plants were kept in the damp chamber for 48 hours and then transferred outside for further observation. No symptoms were noted on the plants during the period of observation.

On January 14, 1956, this experiment was repeated using four potted plants. Two plants were sprayed and the other two directly watered with the mycelial suspension from a 6-day-old culture. The same number of control plants were sprayed and watered with distilled water. Again, no infection was noted on all the inoculated and control plants.

Experiment 3. On November 19, 1955, four sugar-cane cuttings were planted in potted soil mixed with pure culture of the fungus. The same number of control plants were planted in non-infected soil and placed inside the greenhouse for observation. Characteristic symptoms were noted 38 days later on the young leaf sheaths. The whitish mycelium was visible on the sides of the leaf sheaths. The control plants were not infected.

Reisolation of the fungus. Reisolations of the causal fungus were made from the diseased leaf sheath after every inoculation experiment. A comparison of their morphological and cultural characteristics showed that in every case, the reisolated fungus was identical with the original culture.

Varietal susceptibility and resistance. Different varieties in the field, particularly in the Canlubang propagating plots, were observed to differ slightly in their susceptibility to the disease. To confirm this observation, ten varieties of sugar cane were inoculated to determine their relative susceptibility or resistance.

The varieties [2] used were Alunan, Badila, F 109, H 8560, H 37-1933, M 1900, POJ 2714, POJ 2883, POJ 2967 and PSA 76. Two plants of each variety were inoculated and two plants served as control. Four-month-old plants were inoculated with mycelium from 4-week-old cultures. The inoculated plants were incubated in the damp chamber for 48 hours and later transferred outside for further observations.

After 48 hours the plants showed typical symptoms of the disease. All were infected by the fungus although there was a slight difference in susceptibility between the varieties. Varieties H 37-1933, POJ 2883, Alunan, PSA 76, F 109, and POJ 2967 were a little more severely infected than varieties POJ 2714, M 1900, Badila, and H 8560. The results of this experiment confirmed the observations made in the field.

HOST RANGE

In order to determine whether the fungus will infect other plants besides sugar cane, cross-inoculation experiments were conducted. Weeds commonly found in sugar-cane fields were used. These plants were grown in soils contained in pots and cans. When they were well established, they were inoculated with bits of agar containing mycelium from 4-week-old cultures. Control plants were provided for each species. The plants were given the same treatments as those in previous inoculation experiments.

All the inoculated plants were infected by the fungus. These plants, belonging to the family Gramineae, may be listed in the following order on the basis of their susceptibility: Sorghum (*Andro-*

[2] These varieties were secured through the kindness of Mr. Cesar T. Mamon, Canlubang Sugar Estate, Calamba, Laguna.

pogon sorghum [L.] Brot.),[3] cogon, (*Imperata cylindrica* [L.] Beauv.), *Andropogon halepensis* (L.) Brot., *Eleusine indica* (L.) Gaertn., corn, rice, and aguingay (*Rottboellia exaltata* L.f.). The symptoms produced on cogon, sorghum, and *A. halepensis* were identical with those produced on sugar cane. On rice, corn, aguingay, and *E. indica*, the fungus produced water-soaked lesions around the point of inoculation. These lesions later became brown and dry.

Cross-inoculation was also made on abacá (*Musa textilis* Née) since this plant is also attacked by another species of *Marasmius*. The infection on abacá was indicated by the rotting around the point of inoculation. However, the rotting did not spread and did not go deep but it left a dry, much depressed lesion on the stem.

LIFE HISTORY OF THE CAUSAL FUNGUS IN RELATION TO PATHOGENESIS

Seasonal occurrence of the disease. The disease is observed to be prevalent in June, July, August, and September when the sugar-cane plants are still young. It is especially infectious when the ground is wet or moist. Sporophores are usually produced under these conditions.

Methods of infection. It has been shown that infection occurs without necessarily wounding the host. Inoculation experiments showed that as long as sufficient moisture is available, the fungus could directly infect the sugar-cane stems. It is believed that in the field, the fungus can attack the canes even without any previous injury.

Methods of tiding over from season to season. Previous experiments revealed that the mycelium could live for several months in the diseased tissues, and a little longer in artificial media. It is evident from this that the mycelium serves as a means of living over from season to season.

Methods of dissemination. The mycelium which stays in the diseased leaf sheaths may be transported from non-infested fields by adhering to farm implements. Under very favorable conditions, basidiospores produced from the sporophores may be carried to places either by wind or by water. The diseased sugar-cane seed pieces may also act as carriers of the disease.

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[3] Identified by Mr. Juan V. Pancho of the Department of Agricultural Botany.

Sources of inoculum. When left in the fields after harvest, infected leaf sheaths containing the mycelium of the fungus may serve as source of inoculum for the next crop. Weeds may also serve as sources of infection. In the absence of sugar-cane plants in the field, the fungus may be harbored in these weeds. Inoculum from these weed hosts may infect sugar cane in the next cropping season.

CONTROL MEASURES

1) The practice in most sugar-cane areas of burning the stubble and trash left after harvest is recommended because it greatly minimizes the occurrence and spread of the disease during the next growing season.

2) Since weak plants are mostly attacked, thorough and proper cultivation must be done to insure good growth of the canes. In line with careful cultivation, the field must, if possible, be kept free from weeds and other plants which may serve as hosts of the disease.

3) Other varieties not tested in this study must be tried to determine their relative resistance to the disease. In the absence of resistant varieties, however, the following less susceptible varieties are recommended: Badila, M 1900, H 8560, and POJ 2714.

4) Fungicides may be tried.

Three commercial fungicides, Orthocide 50, Manzate, and Dithane D-14 were tested in the laboratory to determine their effectiveness against this fungus. Stock solutions of each fungicide containing 100 per cent concentration were first prepared and from each, one, two, and three per cent solutions were made using potato-dextrose agar instead of water. For each concentration, triplicate cultures were made and in each case control was provided. The agar medium was poured in Petri dishes and inoculated at the center. Daily observations were recorded and the final determination was made after five days.

The fungicides at the concentration used did not completely inhibit the growth of the fungus. However, the fungus on the plates treated with the fungicides grew much slower. Dithane D-14 and Orthocide 50 proved better than Manzate. At two and three per cent concentrations, both gave better growth inhibition. It should be remembered that this work was done in the laboratory and on a very small scale. Further experiment on the rate of application of these fungicides on a bigger scale and under actual field conditions should be done before definite recommendations can be made.

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The test of any economic development program anywhere is whether the six essential requirements of 20th century life and living—food, clothing, housing, health, education, and leisure, are within easy reach of the people.

It is precisely the desire to provide these essential requirements that inspired the rural development program. It is based on simple logic and common sense. If you raise the standards of living of the great bulk of the population, who occupy the base of the economic pyramid, the standards of living of the rest of the country will likewise be raised. The old concept, now discarded except by those living in the past, was for prosperity to filter from the top to the bottom.

—The American Chamber of Commerce Journal

THE RURAL CREDIT SITUATION AND CREDIT EXPERIENCES OF FARMERS IN BAUGUEN, ILOCOS SUR [1]

SILVERIO C. DAYYO

Short-term credit was used by the farmers mainly for subsistence and only a small part for farm operations. Farmers borrowed from private individuals, landlords, and their relatives. Farm supplies constituted the greatest bulk of goods purchased on credit by rural people from local stores throughout the year. Very few of the farmers used mortgage loans which were mainly for buying work animals and building materials. None of the farmers borrowed from banks.

Continued poverty and general backwardness of the rural communities are disadvantageous to a country as a whole. Almost 75 per cent of the people of the Philippines live in rural areas. Because they comprise the majority, the Philippines as a whole is not as economically strong as she ought to be. To achieve national security and strength, the rural population has to obtain the necessary incentives and instruments to enable them to increase their production and improve their level of living. Good credit facilities to help finance the operation of their farms are one of the instruments for helping them.

In 1952, the Agricultural Credit and Cooperative Financing Administration (ACCFA) and the rural banks began to serve the credit needs of farmers in limited areas. These agencies and others need information regarding credit practices, needs, and experiences of farmers, if they are to serve the people adequately and avoid costly errors in their operations.

THE STUDY

This study was conducted to determine the credit situation and experiences of the farm operators in Bauguen, Ilocos Sur, and the relationship of credit problems to size of farm.

All farm operators living in the barrios of Atabay, Dinaratan, Pias, and Malig-cong were interviewed and data on their farm busi-

[1] Central Experiment Station Contribution No. 1932.

ness for the crop year 1954-1955, their credit situation, and experiences serve as the basis of this report.

The four barrios included in the survey are located in the southwestern part of the town along the proposed Bauguen-Santa Lucia road. Although farming is the main source of income farms in this place are irrigated entirely by rain.

THE FARM OPERATORS

Tenure of farmer. Of the 128 farmers surveyed 45 per cent were part-owners and 30 per cent were share-tenants (table 1). The owner-operators were the smallest group composing only one-fourth of the whole.

Age of farm operators. The ages of the farm operators ranged from 22 to 70 years. The average was 44 (table 2). The share-tenants were the youngest group and the full-owners, the oldest. More than two-thirds of the farmers were less than 50 years old.

TABLE 1.—*Age of farm operators*

AGE	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
20–29	12	9	15	12
30–39	31	26	26	27
40–49	22	39	33	33
50–59	13	19	18	17
60–69	16	5	5	8
70 and over	6	2	3	3
Total	100	100	100	100
Average	46	44	42	44

Experience of farm operators. The farm experience of the operators ranged from 1 to 50 years. The full-owners had slightly more experience than the part-owners and share-tenants (table 3). The average was 19 years. More than one-half of the farmers had less than 20 years of farming experience.

Educational attainment of operators. The full owners generally had the greatest number of years of schooling (table 3). The share-tenants had the least. One-fifth of the farm operators did not have any formal schooling. The average schooling was four years. No share tenant had reached the high school level.

TABLE 2.—*Experience of farm operators*

YEARS	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
		percentage		
1–9	28	16	31	24
10–19	31	30	21	27
20–29	13	44	41	35
30–39	16	5	0	6
40–49	12	3	5	6
50 and more	0	2	2	2
Total	100	100	100	100
Average years of experience	20	19	19	19

TABLE 3.—*Educational attainment of farm operators*

SCHOOLING	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
		percentage		
None	12	19	23	19
Primary	44	61	56	56
Intermediate	38	18	21	23
High School	6	2	0	2
Total	100	100	100	100
Average attainment	4	4	3	4

THE FARMS

Size of farms. The average size of farm was 2.2 hectares (table 4). The largest was 8.5 hectares, and the smallest, 0.5 hectare. The full- and part-owners had almost the same farm area. The share-tenants had almost one-third less land than either the full- or part-owners. Ninety-five per cent of the tenants and 63 per cent of all farm operators cultivated two hectares or less.

TABLE 4.—*Size of farms*

HECTARES	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
		percentage		
0.0–1.0	16	[a]	51	21
1.1–2.0	34	49	44	42
2.1–3.0	25	30	5	21
3.1 and over	25	21	0	16
Total	100	100	100	100
Average number of hectares	2.4	2.6	1.4	2.2

[a] Less than one per cent.

Investment. For the full-and part-owners, land was more than one-half of the capital investment (table 6). Disregarding land, the investment was greatest for full-owners. Tenants had only two-thirds as large an investment. For all farms, the average investment, excluding land, was ₱1,368. The value of dwellings and livestock were each about one-third of the item.

TABLE 5.—*Average investments per farm*

ITEM	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
Dwelling	₱ 645	₱ 502	₱ 321	₱ 482
Other buildings	122	106	58	96
Livestock	404	460	402	429
Supplies	359	294	189	278
Implements	79	95	69	83
Total other than land	₱1,609	₱1,457	₱1,039	₱1,368
Land	₱5,024	₱2,021	0	₱2,156
Total	₱6,633	₱3,478	₱1,039	₱3,524
		percentage [a]		
Dwelling	40	35	31	35
Other buildings	8	7	6	7
Livestock	25	32	38	32
Supplies	22	20	18	20
Implements	5	6	7	6
Total	100	100	100	100

[a] Percentage based on total excluding land.

Labor information. The average amount of labor per farm was 263 days, and per hectare, 121 days (table 6). The operator's labor was 43 per cent of the total. Hired labor was only 24 per cent of the total amount of labor in each farm.

The tenants used less labor per farm than either full-owners or part-owners; they may have been less efficient, for they required 154 days to care for a hectare of land, as compared to 116 days for part-owners and 105 days for full-owners. As previously noted, the tenants had the smallest farms. Lack of efficiency is usually associated with the small size of farms.

Expenses. Direct expenses related to crop production constituted the greatest part of all farm expenses for the year (table 7). Land rent was one of the major expenses for part-owners and share-tenants. The average total expenses of all the farm operators was

TABLE 6.—*Average amount of labor per farm*

KIND OF LABOR	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
		days		
Operator	101	130	96	112
Family	72	106	67	86
Hired labor	84	68	46	65
Total	257	304	209	263
		percentage		
Operator	39	43	46	43
Family	28	35	32	33
Hired labor	33	22	22	24
Total	100	100	100	100
Days per hectare	105	118	154	121

TABLE 7.—*Average expenses per farm*

ITEM	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
Crops to landlord	—	₱175	₱174	₱131
Cash:				
Hired labor	₱ 96	89	47	78
Capital purchases	[a]	18	1	8
Direct expenses	290	389	223	314
Other expenses:				
Unpaid operator's labor	115	150	134	136
Unpaid family labor	83	116	75	95
Decrease in inventory	[a]	[a]	3	1
Total	₱584	₱937	₱657	₱763

[a] Figures less than fifty centavos.

₱763. If rent for land use had been paid by the owner-operators, all the farmers would have had similar expenses per farm with the part-owners' expenses being somewhat larger.

Value of crops produced. Rice was the most important crop produced (table 8). Its value amounted to almost one-half of the total value of crops per farm. Next was tobacco and least important of the major crops was corn. Other crops were vegetables and fruits, mostly produced as catch crops and backyard plantings. The average value of the crops produced per farm was ₱928. The part-owners produced the most, and share-owners, with smallest farms, produced the smallest value per farm.

TABLE 8.—*Value of crops produced per farm* [a]

CROP	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
Rice	₱383	₱ 504	₱333	₱421
Tobacco	155	252	213	216
Corn	8	46	18	28
Other	359	339	74	263
Total	₱905	₱1,141	₱638	₱928

[a] Includes crops shared with landlord, sold and used at home.

Non-farm income. (a) *Operator.* The average non-farm income of the farm operators was ₱140 (table 9). The part-owners received the highest non-farm income among the three tenure groups. The full-owners had the smallest income. In general, the farmers with small farm holdings did more work off their farms than the farmers with large farm holdings.

TABLE 9.—*Average non-farm income of operator by size per farm.*

HECTARES	FULL-OWNER		PART-OWNER		SHARE-TENANT		ALL FARMS	
	Months	Value	Months	Value	Months	Value	Months	Value
0–1.0	3	₱102	4	₱185	4	₱148	3	₱142
1.1–2.0	2	69	3	153	3	154	3	136
2.1–3.0	2	85	3	179	2	60	2	142
3.1 and more	2	109	3	164	0	0	2	142
Average	2	₱ 88	3	₱164	3	₱146	3	₱140

(b) *Family.* The non-farm income of the operators' family averaged ₱217 (table 10). The family non-farm incomes of the share-tenants (₱220) and part-owners (₱229) were nearly the same. The families of the farmers with large landholdings received more non-farm income than those with small holdings. This may have been due to the industry of the members while waiting for their crops to mature.

TABLE 10.—*Family non-farm income by size per farm*

HECTARES	FULL-OWNER		PART-OWNER		SHARE-TENANT		ALL FARMS	
	Months	Value	Months	Value	Months	Value	Months	Value
0–1.0	3	₱106	6	₱175	4	₱178	4	₱165
1.1–2.0	4	154	4	147	8	292	5	194
2.1–3.0	2	83	6	183	2	38	4	143
3.1 and more	9	399	10	482	0		9	448
Average	5	₱190	5	₱229	6	₱220	5	₱217

Receipts, value of family living, and gross income. Crops and farm privileges constituted over one-half of the total returns of the farm operators (table 11). The smallest source of receipts came from the animals and animal products. The value of the total receipts per farm was ₱1,301. The full- and part-owners had the same average receipts, value of living, and gross income per farm. The share-tenants had very much less than full- and part-owners.

TABLE 11.—*Average receipts, value of family living, and gross income per farm by type and tenure*

RECEIPTS	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
Crops	₱ 562	₱ 557	₱296	₱ 479
Farm privileges	364	381	127	300
Family non-farm income	190	229	221	217
Operator's non-farm income	88	164	146	140
Animals and products	11	162	26	85
Other sources	171	63	33	81
Total	₱1,386	₱1,556	₱849	₱1,302

CREDIT USED BY FARMERS

Source and number of short-term loans. More than one-half of the farmers surveyed used short-term credit, the primary source of which was private individuals (table 12). Landlords and relatives of the borrowers were other important sources. One-fifth of the full-owner, one-half of the part-owners and four-fifths of the share-tenants borrowed on short-term loans.

TABLE 12.—*Source and number of short-term loans*

SOURCE	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
		number		
Landlords	0	9	13	22
Private individuals	6	20	18	44
Others	0	0	1	1
No loan	26	28	7	61
Total	32	57	39	128
		percentage		
Landlords	0	16	33	17
Private individuals	19	35	46	34
Others	0	0	3	1
No loan	81	49	18	48
Total	100	100	100	100

Size of short-term loans. The average size of short-term credit loans was ₱63 (table 13). The smallest loan was ₱35 and ₱150 was the largest. Farmers operating two hectares and less constituted more than 80 per cent of the total farmers who used short-term loans. In all tenure groups the operators of small farms used more short-term loans than did those of large farms.

TABLE 13.—*Average size of short-term loans by size of holding*

HECTARES	FULL-OWNER		PART-OWNER		SHARE-TENANT		ALL FARMS	
	No. of loans	Ave. per loan	No. of loans	Ave. per loan	No. of loans	Ave. per loan	No. of loans	Ave. per loan
0–1.0	1	₱ 50	2	₱ 35	16	₱ 56	19	₱ 54
1.1–2.0	4	45	14	40	49	85	33	61
2.1–3.0	0	—	6	35	1	140	7	50
3.1 and more	1	150	4	120	0	—	5	126
Total or average	6	₱ 63	26	₱ 51	32	₱ 72	64	₱ 63

Security for short-term loans. Only two of the farmers who used short-term credit were required to execute promissory notes (table 14). Of the borrowers 90 per cent did not give any collateral. The security was based on the character of the borrowers and their standing in the community. The tenants did not have any security for loans secured from their landlord.

TABLE 14.—*Security of short-term loans*

SECURITY	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
		number		
None	5	27	31	63
Promissory note	1	0	1	2
Other	0	2	0	2
No loan	26	28	7	61
Total	32	57	39	128
		percentage		
None	16	47	79	49
Promissory note	3	0	3	2
Other	0	4	0	2
No loan	81	49	18	48
Total	100	100	100	100

Purpose of short-term loans. There were six major purposes for short-term loans (table 15). The most important was for sub-

sistence. Five of the full-owners used the money for subsistence and others for farming operations. More than one-half of the farmers used short-term credit for subsistence.

TABLE 15.—*Purpose of short-term loan*

PURPOSE	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
		number		
Subsistence	5	26	29	60
Field preparation	1	14	8	23
Cultivation	0	5	7	12
Harvesting	1	3	3	7
Planting	1	1	4	6
Purchase of seed	1	5	0	5
Other	1	1	0	2
Total	9	55	51	115
		percentage		
Subsistence	56	47	57	52
Field preparation	11	26	15	20
Cultivation	0	9	14	11
Harvesting	11	5	6	6
Planting	11	2	8	5
Purchase of seed	0	9	0	4
Other	11	2	0	2
Total	100	100	100	100

TABLE 16.—*Source and number of long-term loans used by farm operators*

SOURCE	FULL-OWNERS	PART-OWNER	SHARE-TENANT	ALL FARMS
		number		
Businessmen	0	1	3	4
Relatives	1	1	2	4
Landlords	0	2	3	5
Merchants	1	3	1	5
Private individuals	2	5	1	8
Total	4	12	10	26
		percentage		
Businessmen	0	8	30	16
Relatives	25	8	20	16
Landlords	0	17	30	19
Merchants	25	25	10	19
Private individuals	50	42	10	30
Total	100	100	100	100

Source of long-term loans. There were five sources of long-term loans: relatives, landlords, businessmen, merchants and private individuals (table 16). None of the farmers borrowed from banks because banks do not lend readily and they required fixed capital as security.

Amount of long-term loans. The average amount for a long-term loan was ₱168 (table 17). The range was ₱100 to ₱300. The part-owners borrowed larger long-term loans than either the full-owners or share-tenants. The size of holdings showed no relationship to the size of loans.

TABLE 17.—*Average size of long-term loans by size of farm*

HECTARES	FULL-OWNER		PART-OWNER		SHARE-TENANT		ALL FARMS	
	No. of loans	Ave. per loan	No. of loans	Ave. per loan	No. of loans	Ave. per loan	No. of loans	Ave. per loan
0–1.0	1	300	0	—	3	167	4	200
1.1–2.0	3	100	7	154	7	147	17	142
2.1–3.0	0	—	3	233	0	—	3	233
3.1 and above	0	—	2	175	0	—	2	173
Total or average	4	150	12	178	10	153	26	168

Purpose of long-term loans. More than one-half of the loans were used to purchase animals (table 18). The next largest use of long-term loans was the purchase of housing materials. The part-owners had a wider variety of purposes for loans than any of the other groups.

TABLE 18.—*Purpose and number of long-term loans used by farm operators*

PURPOSE	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
		percentage		
Purchase of animals	50	41	70	54
Purchase of house	25	17	20	19
Food	0	25	10	15
Education	0	17	0	8
Medical	25	0	0	4
Total	100	100	100	100

Interest of long-term loans. The interest rates of long-term loans ranged from 10 to 30 per cent (table 19). About one-fifth were able to borrow at less than 10 per cent. Three-fifths of the loans had rates of 21-30 per cent. In the survey no borrower was charged more than 30 per cent.

TABLE 19.—*Interest rates of long-term loans used by farm operators*

PERCENTAGE INTEREST RATE	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
		percentage		
10 and below	25	8	30	19
10 to 20	50	17	10	19
21 to 30	25	75	60	62
Total	100	100	100	100

Store credit. Four-fifths of the full-owners, two-thirds of the part-owners, and about one-half of the tenants used store credit (table 20). The store owners were mostly Chinese; only few were Filipinos.

TABLE 20.—*Use of store credit by farm operators*

TENURE	FARMERS USING		FARMERS NOT USING	
	Number	Percentage	Number	Percentage
Full-owner	25	31	7	15
Part-owner	36	44	21	45
Share-tenant	20	25	19	40
Total	81	100	47	100

Items used on store credit. Farm and school supplies and food constituted the greatest part of the purchases with store credit

TABLE 21.—*Items purchased with store credit* [a]

ITEM	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
		number of items reported		
Farm supplies	22	26	19	67
School supplies	18	16	14	48
Food	9	13	17	39
Clothing	2	4	8	14
Others	2	0	0	2
Total	53	59	58	170
		percentage		
Farm supplies	42	44	33	40
School supplies	34	27	24	28
Food	17	22	29	23
Clothing	4	7	14	8
Others	3	0	0	1
Total	100	100	100	100

[a] Some farmers bought more than one type.

(table 21). Farm supplies were two-fifths of the total. School supplies and food were next in that order. Of the different items bought on store credit, farm and school supplies and food constituted 90 per cent of the total.

Monthly use of store credit. Most of the farmers used store credit in the months of June, July, October, November, and December (table 22). The reason for the heavy use of store credit in June was the need for finances at the time of the preparation of the fields. The farmers used credit in October, November, and December because the crops were not yet harvested.

TABLE 22.—*Months of use of store credit by farm operators*

MONTH	FULL-OWNER	PART-OWNER	SHARE-TENANT	ALL FARMS
January	11	8	5	24
February	11	6	6	23
March	12	7	2	21
April	12	8	2	22
May	14	11	5	20
June	22	21	14	57
July	14	18	11	43
August	12	14	10	36
September	11	14	14	39
October	19	19	11	49
November	19	16	13	48
December	18	22	14	54
Average	14	14	9	36

* * *

". . . the ACCFA consequently puts emphasis on the need for greatest participation possible on the part of the land workers to attain the goal of self-sufficiency and contentment in the rural regions. Farmers and their families are urged to share in increasing proportion in the burden of conducting and managing the various enterprises which the ACCFA has put up for their interests."

—*The Cooperative Farmer*
Vol. IV, No. 8, August, 1956

SOCIO-ECONOMIC CONDITIONS OF SETTLERS IN KIDAPAWAN, MINDANAO [1]

PEDRO R. SANDOVAL [2]

WITH ONE TEXT FIGURE

Of the settlers interviewed in Kidapawan, 58 per cent came from the Visayas; 17 per cent, from Luzon; 17 per cent were natives of Cotabato; and 8 per cent came from other provinces of Mindanao. Farming was the main occupation of 64 per cent of the household heads in their home provinces. To acquire land was their primary motive in migrating to the settlement. More than two-thirds did not own land in their former homes. Of the farms being operated by them, 60 per cent were 5 hectares or less; 27 per cent, 5.1 to 10 hectares; 8 per cent, 10.1 to 24 hectares; and 5 per cent were lots of over 24 hectares. On the average, only a little over one-half or 54.2 per cent of the farm area was under cultivation.

The settlers' farms were inadequately equipped. Rice and corn were the major crops; coffee, abacá, and ramie were the minor crops. There was a low farm productivity which may be due to improper farm practices. The principal problems were: (1) lack of feeder roads; (2) lack of tools and equipment; (3) lack of work animals; (4) marketing of farm products controlled by aliens; (5) prevalence of plant pests and diseases; and (6) lack of capital for farming operations. To improve the settlers' socio-economic conditions, the suggestions for governmental action were: (1) build more feeder roads; (2) provide credit facilities; and (3) expedite issuance of land titles.

Land settlement and development of the public domain in the Philippines has been in progress during the last half century. The public land policy has been directed towards encouraging people from the more crowded areas of Luzon to settle on promising but undeveloped agricultural lands in other parts of the islands. Since this program is likely to continue, information on the economic and social conditions of settlers is vital to the formulation of policies and sound administration of land settlement programs.

Settlements in the Philippines may be divided into two types, the organized or guided settlement and the voluntary or unorganized

[1] Central Experiment Station Contribution No. 1933. A part of Project No. 395.

[2] The author is grateful to Messrs. Jesus C. Sta. Iglesia and Felipe V. Cagampang for their assistance in gathering the information and to Dr. Philip M. Raup, Professor of Agricultural Economics, University of Minnesota, for his suggestions.

settlement of the public domain. The former is exemplified by the Koronadal settlement [3] in Cotabato where settlers receive assistance from a government agency, the National Resettlement and Rehabilitation Administration.

In the unorganized land settlement, the settlers or "pioneers" receive no aid from the government in the form of transportation expenses, farm homes, work animals, agricultural machinery and equipment, etc., except the land. These public lands are either bought through public bidding or applied for as homesteads from the Bureau of Lands. Kidapawan typifies this type of settlement.

KIDAPAWAN SETTLEMENT

Kidapawan is in Cotabato and comprises the area that surrounds the western base of Mount Apo in Mindanao.[4] The settlement has an approximate area of 100,000 hectares, subdivided as follows: agricultural area, 55,000 hectares; unclassified area, 40,000 hectares; and forest land, 5,000 hectares.

Settlement of this area began in 1936 when the Cotabato-Davao national highway was opened. Public land subdivision was started by the Bureau of Lands on September 17, 1936. Prior to that period, the area was populated by non-Christian natives who led a nomadic existence and subsistence by the "kaingin" method of farming.

The original plan of subdivision of the Bureau of Lands was to create five-hectare lots in the area lying within a distance of one kilometer on either side of the national highway, and ten-hectare lots in the areas between the first and second kilometers. With the extension of the subdivision to include all area released by the Bureau of Forestry for agricultural purposes, the lands lying between the third and fourth kilometers from the highway were subdivided into 50-and-100-hectare lots for individual sales applicants. Those three kilometers distant and more were parcelled into 500 and 1,000 hectare lots for possible sale to corporations.

The pattern of farm lots beyond the third kilometer did not develop as planned. As more people came to settle, they occupied even the areas intended for individual sales applicants and corporations although many of those lots were then still covered by existing

[3] This was the first organized land settlement under government direction and support.

[4] One hundred settlers were interviewed in this area in April, 1955.

applications. These big lots were subsequently subdivided after the so-called "squatters" had cleared and cultivated their respective portions. The original applications were cancelled for lack of interest on the part of the earlier applicants. This resulted in the predominance of small-sized farms. Table 1 shows the distribution of farm lots in the settlement.

TABLE 1.—*Distribution of farm lots by size in Kidapawan, Cotabato, 1955* [a]

SIZE OF FARMS (ha.)	NUMBER OF FARM LOTS	PER CENT DISTRIBUTION
Total	*4,449*	*100.0*
5.0 and below	2,938	66.0
5.1 to 10.0	1,324	29.7
10.1 to 24.0	110	2.5
24.1 to 50.0	56	1.3
50 and over	21	0.5

[a] Data obtained from Survey Party No. 19-A, Bureau of Lands, Kidapawan, Cotabato.

THE PEOPLE

Source of population. Most of the original settlers came from the Ilocos region in Luzon. Later, people from other parts of Luzon and the Visayas started coming to the settlement even without governmental aid (table 2).

TABLE 2.—*Residence of settlers before coming to Kidapawan*

REGION	PER CENT DISTRIBUTION
Total	*100.0*
Eastern Visayas [a]	35.0
Western Visayas [b]	23.0
Luzon [c]	17.0
Natives of Cotabato	17.0
Other provinces of Mindanao [d]	8.0

[a] Leyte, Cebu, Masbate, and Bohol.
[b] Negros Occidental, Capiz, Antique, Romblon, and Iloilo.
[c] Laguna, Pangasinan, Ilocos Norte, Zambales.
[d] Davao and Misamis Oriental.

Reasons for migration. To acquire land was the primary motive of the settlers in migrating to the settlement. More than two-thirds or 60 per cent of the settlers did not have lands of their own in their home provinces.

Seventy-three per cent of the settlers stated that they had either friends, relatives, or neighbors who had moved earlier to the settlement. News of the latter's success played a major role in the increase of settlers. Another reason was the high postwar price of abacá in the area. Government officials and community leaders, in one way or another, influenced the decisions of 9 per cent of the settlers to go to Mindanao. Eight per cent cited newspapers and magazines as responsible for their migration. Only 10 per cent of the settlers reported no outside influence in their decision to move.

Resources of settlers. Most of the homeseekers were people of limited means who came in the hope of bettering their positions. Clothing and personal effects were practically the only property that they brought with them. Only 69 per cent of them had cash upon their arrival in the settlement. For all settlers combined, the average value of resources that they brought was ₱291 in goods and ₱202 in cash. Ninety-five per cent of the settlers did not have any debt upon their arrival at the settlement or before they acquired their land. The remaining 5 per cent had an average debt of ₱527.

The few farming tools brought by the settlers consisted of plows, bolos, and hoes. Work carabaos, cows, and few chickens made up the livestock. The household goods and other property were mostly cooking utensils and few pieces of light furniture. There was a noticeable lack of farming tools, equipment, and work animals.

Occupation of family heads in former provinces. Farming was the main occupation prior to settlement in Kidapawan for 64 per cent of the household heads. Ten per cent were students and another 10 per cent were laborers. Several of them had more than one occupation. Only 6 per cent were not gainfully employed.

Family size and composition of household. Almost 1/3 or 28 per cent of the settlers were single when they arrived at the settlement. Of this original group of single men, only 5 per cent remained single at the time of the survey in 1955. The rest, after finding their farms, got married and raised their families. Only a few of the household members did not belong to the immediate family. They consisted mostly of aged parents and a few non-relatives.

Single men and households with one to three members predominated when the settlers arrived in Kidapawan (table 3). At the time of the survey, there were few single men and more of the bigger households. This tends to indicate a higher degree of mobility of single men and smaller households.

TABLE 3.—*Family size and composition of settlers' households in Kidapawan*

COMPOSITION OF HOUSEHOLD	PER CENT DISTRIBUTION	
	Upon arrival on farm	At the time of survey, 1955
Total	*100.0*	*100.0*
Single	28.0	5.0
Husband and wife only	14.0	8.0
Couple with one child	12.0	11.0
Couple with two children	11.0	13.0
Couple with 3 children	8.0	13.0
Couple with 4 children	9.0	15.0
Couple with 5 children	6.0	13.0
Couple with 6 children	5.0	12.0
Couple with 7 children or more	7.0	10.0

Composition of sample population. Although the total number of males outnumbered the females there was no significant difference between the proportion of the two sexes. However, the classification by age group pointed out the comparative youthfulness of the population. More than half or 54.7 per cent were less than twenty years old. As a contrast, only 3.9 per cent were over 60 years old. This indicates a population with a great potential for further growth.

LAND TENURE AND LAND UTILIZATION

Size of farms. To accommodate the rush of settlers most of the land was subdivided into 5-and-10-hectare lots.

Of the farms being operated by the settlers included in the study, 60 per cent were 5 hectares or less; 27 per cent were 5.1 to 10.0 hectares; 8 per cent were in the 10.1 to 24.0 hectares group; and 5 per cent were lots of over 24 hectares.

While the existing size of farm units may be satisfactory at present, this may eventually constitute another problem in the future. Parcellation of landholdings through inheritance and population pressure on land during the next generation is not improbable.

Tenure status and number of years on the farm. Full-owners accounted for 23 per cent of the settlers; applicants,[5] 47 per cent; tenants, 24 per cent; tenant-applicants, 2 per cent; others, 4 per

[5] The term "applicant" as used in this study refers to the settler actually cultivating his farm because his application for a homestead had been approved. However, the patent or title to the land had not been issued to him, thus rendering him technically an applicant.

cent (table 4). The latter or unclassified group were "squatters" or settlers who were cultivating lands that were not yet released for subdivision and settlement. In this group were also settlers who were cultivating lands belonging to their relatives and were not paying any rent for land-use. They were merely "borrowing" the land until they could find some lots they could apply for.

Thirty per cent of the settlers had been cultivating their farms less than 5 years and 40 per cent had been on their farms more than 5 years but not more than 10 years. There were only two settlers who had been on their farms for over 30 years. One of them was a teacher who started a settlement farm school in the locality and who had been cultivating his farm for 32 years.

TABLE 4.—*Tenure status of settlers by number of years on the farm*

TENURE STATUS	TOTAL	NUMBER OF YEARS ON THE FARM					
		Less than 5	5.0-9.9	10.0-14.9	15.0-19.9	20.0-24.9	25 & above
				per cent			
Total	*100.0*	*30.0*	*40.0*	*2.0*	*21.0*	*3.0*	*4.0*
Full-owners	23.0	—	10.0	—	11.0	2.0	—
Applicants	47.0	6.0	25.0	1.0	10.0	1.0	4.0
Tenants	24.0	21.0	3.0	—			
Tenant-applicants	2.0	1.0	—	1.0			
Others	4.0	2.0	2.0	—			

The large number of applicants who had been occupying their farms for more than 5 years, and in some instances for over 25 years, confirmed the report of the Office of Economic Coordination regarding the delay of the issuance of titles and patents by the Bureau of Lands.[6]

The problem of farm finance is closely associated with the tenure status of the settlers. Since titles and patents are prerequisites to secure funds from credit and lending agencies, the settlers met the same difficulties encountered in other underdeveloped countries —shortage of funds and the task of raising enough capital to develop their resources.[7]

The high percentage of tenants is another aspect of tenure status worth considering. One of the reasons for the present land policy

[6] *Report of the Special Committee on Land Settlement and Title Issuance and Clearance*, Office of Economic Coordination, Manila, 1951, pp. 8-9.

[7] V. Webster Johnson, "Proceedings of the International Conference on Agricultural and Cooperative Credit." University of California, Berkeley, California, Vol. 1, October, 1952, p. 70.

of the government in subdividing public lands into smaller lots is to preclude tenancy. It will be observed, however, that tenancy existed in the new settlement. The tenants were mostly late-comers who were attracted by news of the success of earlier settlers. Unfortunately land had become so scarce and expensive that these late-comers invariably worked as tenants on the lands of those who were ahead of them while waiting for the chance to acquire lands of their own.

While tenancy may not be a problem in the present case, the matter should be looked into carefully in the formulation of future land settlement policies. These tenant-settlers came from provinces where there had been a high incidence of tenancy. In these areas, tenancy had been associated with poverty and other economic ills. These same conditions could reappear in the new settlements. Unless precautionary measures are instituted, land settlement might become only a temporary solution to the problems of land tenure improvement and population pressure on land.

Use of land and type of farming. Only a little over one-half or 54.2 per cent of the farm area was under cultivation. The uncultivated areas were either idle (41.3 per cent) or still uncleared (4.5 per cent). The inability of the settler to utilize fully the productive capacity of his land might be traced to his lack of capital for production requirements such as seed, fertilizer, farm implements, and work animals.

From the standpoint of effective crop area, the settlers were probably not better off in their new farms, especially those who came from high-tenancy provinces where the land had been under intensive cultivation. Even when they had bigger farms than those cultivated in their former homes, they had not tapped the productive potential of these new lands. Their farming had the characteristics of agriculture at the extensive margin although they were in an area suited to intensive agriculture.

According to classical theory, each grade of land is normally put to the type of use for which it is adapted, and it is employed with a proper degree of intensity and with reasonable, or at least, average efficiency. This condition held during the postwar years and prior to 1952. Kidapawan's volcanic soil and well-distributed rainfall made it a very suitable place to grow abacá. With rice and corn as minor crops, abacá planting took priority in the settler's planting operations. However, abacá mosaic infested the abacá plantations and by the end of 1952, a major shift in the pattern of

land use evolved. The abacá farms were gradually replaced by rice and corn farms.

At this juncture, the government intervened to save the abacá industry from being totally wiped out by abacá mosaic. Although plant quarantine measures were enforced, only a few farms were left. Most of these were already showing signs of succumbing to the plant disease. The settlers had no alternative but to use the land for something other than its "highest and best use." This resulted in other types of farming shown in table 5.

TABLE 5.—*Type of farming and average size of farm, Kidapawan, 1955*

TYPE OF FARM	PER CENT OF TOTAL CULTIVATED AREA	AVERAGE SIZE OF FARM IN HA.
Total	*100.0*	
Rice	55.8	3.01
Corn	16.4	1.85
Coffee	9.8	1.57
Abacá	7.0	2.02
Ramie	4.4	5.13
Coconut	3.8	1.46
Other crops[a]	2.8	1.34

[a] Tobacco, citrus orchards, and banana plantations.

Because farming was on a subsistence level, the prevailing crops were food crops. Ramie, a minor crop, had a bigger area per farm, but it constituted only 4.4 per cent of the total area cultivated. The ramie farms belonged to full-owners whose farms were 10 hectares or more and hence, could afford to go into commercial production of non-food crops.

Relation of land utilization to location. In farms which were near markets, land was better utilized than in the isolated farms. Settlers whose farms were along the highway, the roads, and easily accessible trails produced intertilled crops such as vegetables and fruits besides the major crops. These perishable commodities were easily transported to the markets. On the other hand, those settlers living on isolated farms had to raise the non-perishable crops. Whatever perishable commodities they could raise were consumed by the households.

Progress in land cultivation. The settlers had made very little progress in the cultivation of their farms. Figure I shows that the

1-to-5-hectare farms had reached their limit of cultivated area in the fifth year. The 5-to-10-hectare farms took a little longer time. However, farms over 10 hectares might not have felt the pressure to expand the cultivated area. In general, the apparent slow progress and fluctuations in the area cultivated from year to year were due to a number of problems which are discussed in a later section.

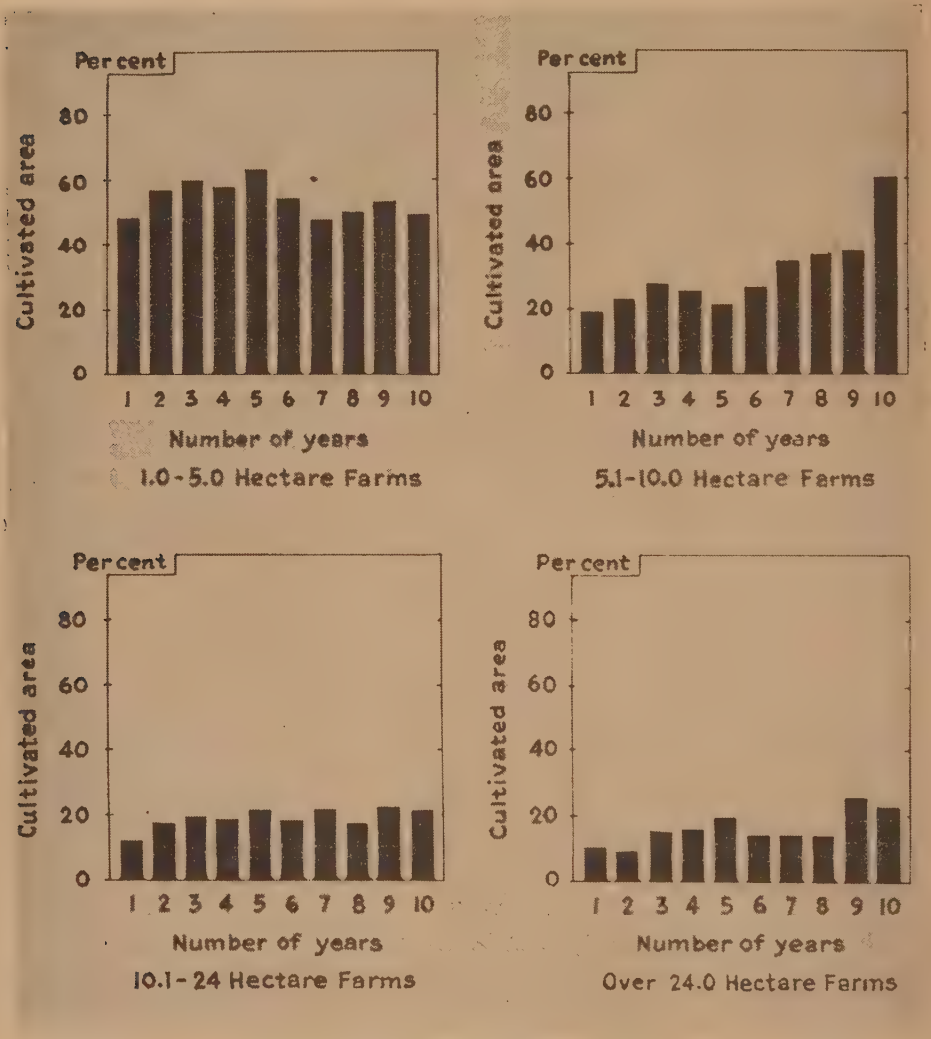

Fig. 1.—Progress in land cultivation.

FARM ORGANIZATION

Crop production and disposal. In general, yields per hectare were low during the period 1954-1955 compared to the average for Cotabato province in previous years (table 6). In 1952, Cotabato had the following average yields: rice, 43.5 cavans; corn, 26.2 cavans; abacá, 22.8 piculs.[8] In 1954, the province had an average yield of 42.8 cavans for rice.[9]

The major part of the food crops was used for home consumption. All the produce from fiber crops was sold to local merchants.

TABLE 6.—*Average yields per hectare of the major crops in Kidapawan, 1955* [a]

CROP	PER CENT OF TOTAL NUMBER OF FARMS REPORTING	YIELD	UNIT
Rice	98.0	32.3	cavans [b]
Corn	77.0	16.3	cavans [b]
Abacá	11.0	19.9	piculs [c]
Ramie	2.0	15.0	piculs [c]

[a] There were no available data for new crops like coffee, coconuts, orchards, and minor crops like tobacco and vegetables.
[b] Per harvest.
[c] Per year.

The low farm productivity may be traced to improper farm practices. Some of these practices were:

1) *Absence of or little attention to seed selection.* The rice and corn seeds planted were often the low-yielding or non-standard varieties.

2) *Faulty preparation of land.* The use of wooden plows and harrows was ineffective in producing good seedbeds, especially in the presence of roots and small stumps.

Moreover, majority of the settlers who were not adequately equipped with farming tools and who did not have work animals resorted to the "kaingin" system of cultivation. The crops were planted between the stumps without plowing or sometimes only with superficial plowing. After two or three years, when weeds became a problem, the original lot was abandoned and an adjacent part placed under a similar process.

3) *Little or no control of pests and diseases.* Except during the height of the abacá mosaic control campaign, little or no use of

[8] Cotabato 1952 Handbook (Goodwill Press, 1952).
[9] 1954 Rice Production Survey, Division of Ag. Econ., DANR.

chemical insecticides and herbicides had been attempted by the farmers.

4) *Limited use of commercial fertilizers.* Generally, corn is planted twice a year. Rice is usually planted only once, followed by a second crop of corn. In some instances, corn is planted three times a year. No provisions were made for the loss of soil nutrients through the use of commercial fertilizers. Only the ramie plantation owners used commercial fertilizers extensively.

5) *Lack of crop rotation.* Nitrogen-consuming crops like rice and corn were planted one after the other. Legumes were planted for food and feeds and not for their usefulness as green manure.

6) *Absence of contouring and terracing of fields.* Some fields showed signs of soil erosion. The more fertile topsoil had been washed away. In a rolling terrain like Kidapawan, soil conservation practices are essential.

7) *Intercropping.* Although in some cases, intercropping might not have any detrimental effect on the main crop, it may adversely affect other crops. In coffee and coconut farms, the practice of planting either rice or corn between the rows might be beneficial since the cultivation keeps down the weeds. However, these crops could also be competing with each other for plant nutrients.

In abacá, it had been established that planting corn as an intercrop or even growing it in the vicinity of abacá plantations is not a sound practice. The corn plants harbor insect vectors that transmit the mosaic disease to abacá.

Livestock. Carabaos and cattle were raised by settlers as a source of farm power. Horses were used for transporting commodities to market. On the other hand, poultry and swine, as well as goats and ducks, were raised for food to a large extent, and as sources of supplementary income. Only 60 per cent of the farms had work carabaos (table 7). The only livestock that could be found on almost all farms were chickens.

To the settlers, the carabao is indispensable in farming. The size of the area under cultivation is, therefore, closely related to the scarcity of work carabaos. The settler had to limit his farming operations if he had to rely on his manual labor and that of his family.

Farm machinery, tools, and equipment. Inventory of the settlers' farm machinery revealed that they were poorly equipped (table

TABLE 7.—*Livestock owned by settlers*

ITEM	PER CENT OF TOTAL NUMBER OF FARMS REPORTING	AVERAGE PER FARM
Work carabao	60.0	1.7
Young carabao	8.0	1.2
Horse	12.0	1.2
Cattle	6.0	2.8
Sow	38.0	1.7
Boar	14.0	1.7
Young pig	46.0	2.9
Goat	5.0	3.8
Chicken	96.0	20.2
Chick	58.0	22.0
Duck	9.0	6.3

8). Only 68 per cent of the farms had plows. The only tool that was generally available was the bolo with 92 per cent of the farms reporting an average of 4.9 bolos to a farm. Most of the gas engines were used to furnish power for the abacá stripping machines and ramie decorticators found in large abacá and ramie plantations. A few were used to run corn shellers, rice mills, portable sawmills, and

TABLE 8.—*Farm machinery, tools, and equipment of settlers*

ITEM	FARMS EQUIPPED	AVERAGE NUMBER PER FARM
	per cent	
Tools and equipment:		
Plow	68.0	1.6
Harrow	57.0	1.2
Cart	13.0	1.3
Sled	43.0	1.4
Bolos	92.0	4.9
Axes	42.0	1.2
Spades	21.0	1.4
Mattocks	20.0	1.1
Shovels	17.0	1.6
Others [a]	21.0	2.0
Machinery and equipment:		
Engine, gas	18.0	1.2
Stripping machine, abacá	17.0	1.0
Other machines [b]	3.0	1.0
Carpentry tools, sets	12.0	1.0
Hand-stripping tools, abacá	6.0	2.3

[a] Weeding tools, hoes, spading fork, crowbar.
[b] Ramie decorticator, corn mill, rice mill, corn sheller, winnower, portable sawmill.

electric generators. Of the farms surveyed, only one was partly mechanized. It was equipped with a track-laying tractor together with plowing and harrowing equipments.

Labor force and source of income. The labor force included all persons over 14 years old who worked on their farms or those who received wages and salaries for their account one or more days prior to April 15, 1955, and those who were not employed at that period excluding housewives and children at school.

More than half of the population or 51.3 per cent was in the labor force, with housewives and school children accounting for the 48.7 per cent that was not in the labor force. Incidentally, 5.8 per cent of the housewives did some part-time work on the farm (table 9).

TABLE 9.—*Distribution of population, 14 years old and over, by classes and sex, in Kidapawan*

CLASS	PER CENT		
	Total	Male	Female
Total population 14 years old and over	*100.0*	*53.3*	*46.7*
In labor force:	*51.3*	*42.3*	*9.0*
Employed			
Farming	37.4	36.0	1.4
Non-farming	5.2	4.0	1.2
Unemployed			
Under 65 years old	6.6	1.4	5.2
65 years old and over	2.1	0.9	1.2
Not in labor force:	*48.7*	*11.0*	*37.7*
Housewives	27.6 [a]	—	27.6
Students	21.1	11.0	10.1

[a] Of the housewives, 5.8 per cent did part-time work on the farm.

Farming accounted for 73.0 per cent of the employed persons; non-farming jobs, 10.1 per cent. The men, 70.2 per cent, predominated the women, 2.8 per cent, in farm work. Only 12.9 per cent of persons under 65 years old were unemployed, and 10.1 per cent of these were women (table 10).

Ninety-one per cent of the settlers operated their farms, either as owners or tenants. Of the remaining 9 per cent, 6 per cent were landlords and 3 per cent operated their farms by hired labor. Because of the settlers' inability to hire labor, it was a very common practice for them to exchange labor with neighbors and friends during the season of land preparation, planting, and harvesting.

TABLE 10.—*Composition of labor force*

CLASS	PER CENT		
	Total	Male	Female
Total in labor force:	*100.0*	*82.5*	*17.5*
Employed:			
Farming	73.0	70.2	2.8
Non-farming	10.1	7.8	2.3
Unemployed:			
Under 65 years old	12.9	2.8	10.1
65 years old and over	4.0	1.7	2.3

Seventy-eight per cent of the settler-operators worked full-time on their farms during the year and reported no other source of income. Thirteen per cent augmented their farm income by working as laborers during the slack season of farming which ranged from two to six months. Landlords and manager-operators had more lucrative non-farm jobs.

Farm credit. In spite of the farmers' need for credit assistance and the availability of credit, 79 per cent of the settlers did not borrow money during the crop year under consideration. Twenty-one per cent received loans from their landlords, relatives, friends, neighbors and the PNB. Only the PNB charged interest (6%) for these loans. One settler was able to borrow ₱28,000 from the Rehabilitation Finance Corporation for building and agricultural purposes. This loan was payable on a ten-year amortization basis at 6 per cent interest. At the time of the survey, a Farmers' Cooperative Marketing Association (FACOMA) affiliated with the ACCFA had been organized in the settlement, and loan applications of farmer-members were being processed. However, only 11 per cent of the settlers interviewed were members of this organization.

The reasons advanced by the settlers for not borrowing any money were: (1) loan applications from the FACOMA had not yet been approved; (2) friends and neighbors did not have money; (3) landlords had no money; (4) untitled lands could not be mortgaged; and (5) conditions of loans were unsatisfactory.

Markets and marketing farm products. In the settlement, the market had a very limited scope. The only evidences of marketing functions were buying and selling. A large bulk of the food crops raised by the settlers was used for home consumption. The barrio stores at the junctions of barrio trails and roads on the national

highway were the usual outlets for the surplus farm produce. Majority of these stores were either owned by or served as purchasing agents for alien merchants. The settlers obtained most of their primary staples from these stores. In general, the settlers received lower prices for their farm produce and paid higher prices for the essential commodities than residents in the town proper.

The absence of roads resulted in high transportation costs. Most of the products were hauled from the settlement farms to the stores or buying agencies by horseback, carts and sleds, and oftentimes carried on men's shoulders.

The cost of hauling varied with the distance from the farm to the market; the farther the distance, the higher the cost. This ranged from ₱0.03 to ₱0.07 per kilogram of commodity over distances ranging from six to twenty kilometers from the highway. The transportation cost of palay weighing 46 kilograms ranged from ₱1.38 to ₱3.22. Settlers living along the roads and the national highway accessible to motor vehicles paid only ₱0.10 to ₱0.30 per sack for the comparable distance. It was evident, therefore, that settlers in districts where roads and markets were available had many advantages over those who settled further into the hinterlands.

LEVEL OF LIVING

Housing. In general the houses of the settlers were small, inexpensive and usually built of bamboo, sawali, nipa and other materials available in the locality. All settlers owned their houses and many owned other buildings such as storehouses, sheds for animals and equipment. Twenty-one per cent owned two to three. Houses built of light materials had an average value of ₱175; those with mixed strong and light materials, ₱463, and strong materials, ranging from ₱1,000 to ₱8,000. Kerosene lamps supplied the light of 96 per cent of the settlers; the rest depended on electricity. Water was obtained from private and communal wells and other natural sources as rain, streams and springs.

Most of the houses were small, and furnishings were extremely scanty. Toilet facilities were limited to open pits, Antipolo or semi-flush and other types. The more progressive settlers had better houses and more furnishings.

Almost all the dwellings were anchored on wood or bamboo pilings, with floors 1½ to 2½ meters off the ground. The large

space underneath served as sheltered storage area for tools, equipment, and harvested crops for those who did not have any separate storehouse or tool shed. This was similar to the operation made by Rivera and McMillan.[10]

Community conditions. About one-third of the settlers were living in barrios. The rest were residing in smaller units of barrios called *sitios* or in isolated farmsteads where homes were 300 to 500 meters apart. A typical barrio consisted of one or more clusters of houses with relatively few families. It had its own schoolhouse, a barrio chapel, and oftentimes a communal reading center. The barrio stores sold primary staples.

The residents of a barrio usually came from the same region and very often were kinfolks. Most of the barrio names suggested the settlers' origin. Each community often celebrated its traditional annual fiesta in honor of the patron saint of the settlers' former hometown or locality.

Education. Most of the schoolhouses were made of light materials and were built through the leadership of the barrio teacher. Parents often furnished the buildings, desks, and other equipment.

Seventy per cent of the population, 6 to 19 years old, were attending school at the time of the survey. Among children 10 years old and over, 14.6 per cent were illiterate. Four out of every five persons 20 years old and over had had some schooling. The highest grade completed by this age group is shown in table 11.

TABLE 11.—*Highest grade completed in school by persons 20 years old and over*

HIGHEST GRADE COMPLETED	PER CENT DISTRIBUTION		
	Total	Male	Female
All grades	*100.0*	*59.3*	*40.7*
1–4	40.2	22.0	18.2
5–7 [a]	27.7	13.0	14.7
8–11	17.2	13.3	3.9
12 and over	14.9	11.0	3.9

[a] One grade was eliminated in 1941.

Apparently fewer females went beyond the elementary grades. Most of them got married before they had a chance to go to high school.

[10] Generoso F. Rivera and Robert T. McMillan, *The Rural Philippines*, PHILCUSA-MSA, Manila, Philippines, October, 1952, p. 141.

Health and welfare. The services of the government physician were available only to town residents and settlers who were able to come for consultation in his office. There were a number of private practising physicians and clinics but majority of the settlers could not afford to pay for their services. However, there was a puericulture center in town financed by women's civic organizations and charity funds of the Philippine Charity Sweepstakes. It was staffed by a registered nurse and volunteer social workers. The local physicians took turns in giving services at the puericulture center free of charge.

Community opportunities. Since the settlers were mostly kinfolks or close friends in their home provinces, frequent family social contacts with neighbors were reported. Cooperative work in the fields during planting and harvest time was common.

The dominant organizations in community improvement were the *Puroks* and Parent-Teachers' Association, organized under the auspices of barrio teachers. These organizations often set up community self-help projects without assistance from the government. Some of these projects involved improvement of barrio roads, construction of sanitary facilities, and establishment of reading centers.

All parents who had children in school automatically became members of the PTA. The main concern of this association was the betterment of the school and its facilities. Parents often contributed money and labor to build and improve the schoolhouse. Other organizations were the FACOMA, Barangay of the Virgin, Catholic Men's (Women's) League, etc.

Families of settlers had a number of receational activities. Attending fiestas, parties, baptisms, and wedding ceremonies were shared by persons of all ages. The other recreations of the different groups follow: (1) farm operators: cockfighting, movies, reading vernacular magazines and newspapers, witnessing ball games between local teams; (2) wives: going to movies, visiting friends and neighbors, reading magazines and newspapers; (3) sons, 14 years old and over: going to movies, ball games, reading newspapers and magazines, neighborly visits, and serenading; and (4) daughters, 14 years old and over: going to movies, reading newspapers and magazines, neighborly visits, and dancing. The younger children usually stayed at home and enjoyed children's games.

In 1954-1955, eighty-three per cent of the settlers attended meetings held in the community; 15 per cent did not attend; and 2 per

cent did not know whether there was any meeting held. Seventy per cent of the settlers attended community assemblies sponsored jointly by the Bureau of Public Schools, Bureau of Agricultural Extension, Bureau of Plant Industry, and Bureau of Health. Seventeen per cent attended the organizational meeting of the FACOMA sponsored by the ACCFA. Ten per cent attended the organization of the barrio council by the BAE and 8 per cent, the PUROK organization by the Bureau of Public Schools.

Religion played an important role in the social life of the settlers. Ninety-nine per cent of the population were church members (table 12). Almost every barrio had its own chapel since 70 per cent of the settlers were Catholics. Of the non-Catholics, only the Islams had their mosque or chapel in their barrio. The chapels and churches of the other sects were located in the town and its outskirts.

TABLE 12.—*Religious affiliation of the settlers*

ITEM	PER CENT DISTRIBUTION
Total	*100.0*
Roman Catholics	70.0
Mohammedans	16.0
Protestant sects	6.0
Other religions	7.0
Pagan	1.0

Transportation facilities. Trucks, buses, and jeepneys, furnished transportation in places accessible to roads. Within the settlement, walking was the chief means of travel. Horses were also often utilized. Commodities were transported to markets by horses, sleds and carts pulled by carabaos, and sometimes by men who carried them on their shoulders.

GOVERNMENTAL ASSISTANCE AND COMMUNITY SELF-HELP

Governmental assistance. The center of the local government in Kidapawan is the Municipal Hall. Almost all the agencies of the government providing basic services in the municipal level have their offices in this building. The Bureau of Agricultural Extension maintains a plant propagation nursery in the municipality. The Bureau of Plant Industry has also its representative. The extent to which the settlers availed themselves of these services is shown in table 13.

TABLE 13.—*Government help received by settlers in Kidapawan*

OFFICES AND NATURE OF HELP RECEIVED	PER CENT OF SETTLERS RESPONDING
A. *Bureau of Lands: Total*	*100.0*
Preparation of application papers	28.0
Order of award or patent issued	7.0
Resurvey of lot	5.0
Survey of land	6.0
Conversion of sales application to homestead	1.0
Relocation of boundaries	1.0
None	52.0
B. *Bureau of Agricultural Extension: Total*	*100.0*
Agricultural Information	11.0
Visits of home demonstrator	1.0
Occasional planting materials	1.0
Services of boar	1.0
None	86.0
C. *Department of Health*	
1. Malaria Control Unit—*Total*	100.0
Houses sprayed with DDT 2 times	99.0
None	1.0
2. Bureau of Health: *Total*	*100.0*
None	100.0
D. *Bureau of Plant Industry: Total*	*100.0*
Eradication of abacá mosaic	26.0
Rat control	11.0
Distribution of insecticides	7.0
Distribution of planting materials	6.0
Advice on pests and diseases	1.0
None	49.0
E. *Bureau of Public Works: Total*	*100.0*
Road construction in 1954	34.0
None	66.0
F. *Other Agencies: Total*	*100.0*
Visits from various agencies	4.0
1. Philippine Constabulary	
2. ACCFA fieldmen	
3. College of Agriculture fieldmen advice on coffee disease	
None	96.0

Community self-help. The strong desire to improve their community living in spite of limited resources was clearly manifested by the willingness and cooperation shown by settlers in the accomplishment of community self-help projects. Through their own efforts and through the able guidance of barrio teachers, barrio

schools were repaired or built, barrio trails widened and improved, and their own surroundings cleaned and beautified.

ATTITUDES AND OPINIONS OF SETTLERS

Attitude toward settling in the place. The settlers were almost unanimous that they were happy they settled in the place. Only 4 per cent regretted that they ever migrated, and 2 per cent were doubtful. The majority agreed that in spite of the difficulties they encountered in their new homes, the settlement was a good place to live in and their chances of success with their farms were better than they had been in their former homes. A number of them indicated that the success and prosperity of those who came earlier to the settlement had lured them to gamble on the prospect of meeting the same degree of success.

None of those who were happy to have settled in the place expressed desire to move back to their home provinces. Only those who were either sorry or of questionable opinion expressed their desires to return to their former homes. However, given the chance, 11 per cent of the settlers wanted to move elsewhere. When queried as to where they would like to go, the following opinions were given: (1) anywhere in the province, 2 per cent; (2) other provinces in Mindanao, 5 per cent; (3) anywhere except in Luzon, 1 per cent; (4) near the sea, 1 per cent; (5) undecided, 3 per cent.

The group that expressed a desire to move elsewhere had varied reasons for doing so. Four per cent wanted to own land inasmuch as they were renting the land they were cultivating. Three per cent were interested in looking for better living after the failure of their mosaic-infested abacá plantations. The other reasons were: (1) difficulty in buying fresh fish and (2) difficulty in finding cheap lands.

Principal problems of settlers. There was a wide diversity of opinion regarding their principal problems. The need for feeder roads took the lead as the foremost problem. The other problems are presented in table 14.

Suggestions for governmental action to better conditions of settlers. Forty-six per cent or almost half of the settlers believed that the government should build feeder roads especially in the remote settlements. Twenty-three per cent opined that providing credit facilities should be the next concern of the government. The distribution of their suggestions is shown in table 15.

TABLE 14.—*Problems of settlers*

ITEM	PER CENT OF TOTAL NUMBER OF SETTLERS RESPONDING
Lack of feeder roads	39.0
Lack of tools and equipment	38.0
Lack of work animals	36.0
Marketing of farm products controlled by aliens	28.0
Prevalence of plant pests and diseases	25.0
Lack of capital for farming operations	23.0
Lack of title to land	18.0
Inadequate land	8.0
High prices paid for commodities needed for family living	5.0
Very far from physicians and drug stores	5.0
Non-committal	4.0
Low prices of farm products	3.0
Unsanitary water supply	1.0
Shortage of food and always in debt	1.0
None	1.0

TABLE 15.—*Suggestions of settlers for governmental action*

ITEM	PER CENT OF TOTAL NUMBER OF SETTLERS RESPONDING
Build more feeder roads	46.0
Provide credit facilities	23.0
Expedite issuance of land titles	17.0
Government aid of unspecified kind	11.0
Control prices	10.0
Control plant pests and diseases	10.0
Accelerate distribution of land	9.0
Provide good markets for products	8.0
Build more schools	7.0
Solve land ownership problem	5.0
Provide tractor pools or work animals	2.0
Provide agricultural information	2.0
Provide rural health centers	2.0
Provide sanitary drinking water	1.0
Send peace and order officials to barrios more often	1.0

Health hazards. Malaria was considered by 94 per cent of the settlers as the most serious health hazard. Diseases of minor importance were: dysentery, tuberculosis, influenza, beri-beri, typhoid, hookworm, and skin diseases.

Other hazards. Two-thirds or a majority of the settlers thought there was no serious hazard in the settlement. The minor hazards were wild hogs, natives running amok, robbers and thieves.

ERRATUM

In volume XL, No. 8, January, 1957 number of *The Philippine Agriculturist* page 424, the last line of Table 3 "Ave. weight of grains per panicle (gm.)" should read "Ave. weight of grains per pot (gm.)" and the paragraph immediately following, "The highest number . . . and for lot III, 98.46 grams.", should be deleted.

THE CENTRAL EXPERIMENT STATION

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